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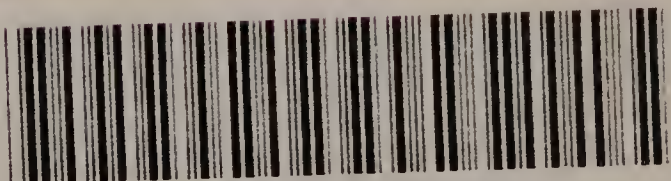
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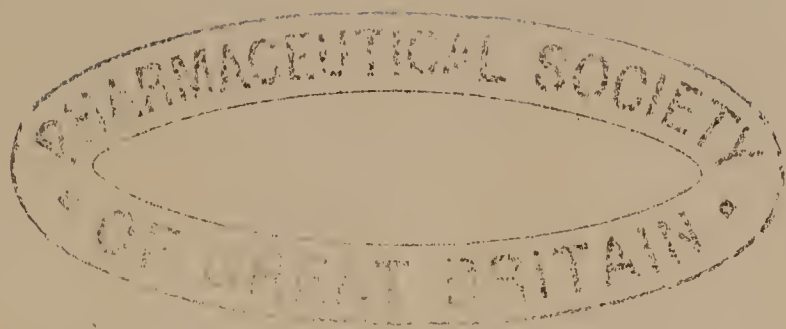
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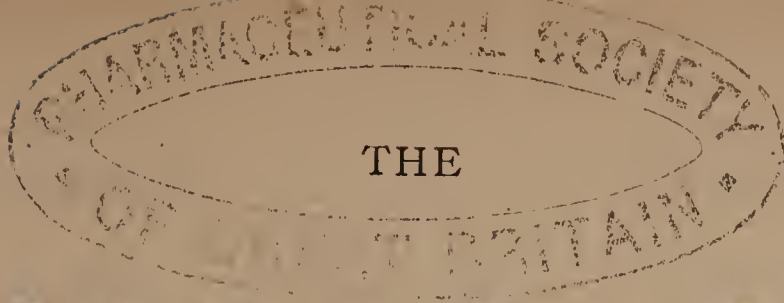












# CHEMICAL NEWS

AND

JOURNAL OF PHYSICAL SCIENCE.

(WITH WHICH IS INCORPORATED THE "CHEMICAL GAZETTE.")

*A Journal of Practical Chemistry*

IN ALL ITS APPLICATIONS TO

PHARMACY, ARTS, AND MANUFACTURES.

EDITED BY

*WILLIAM CROOKES, F.R.S., &c.*

VOLUME XXII.—1870.

LONDON:

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# THE CHEMICAL NEWS.

VOLUME XXII.

EDITED BY WILLIAM CROOKES, F.R.S., &c.

No. 553.—FRIDAY, JULY 1, 1870.

## THE ELECTRO-DEPOSITION OF COPPER AND BRASS UPON IRON.

By W. H. WALENN, F.C.S.

THE early attempts to electro-coat iron with copper were unsuccessful, in consequence of all acid and neutral solutions of copper acting upon articles of iron immersed therein. This difficulty was overcome soon after Elkington's electro-silvering process was made known (in 1840) by using alkaline solutions. Alkaline sulphites, hyposulphites, cyanides, ferrocyanides, and other salts, also a mixture of these, have been used, the only salts that stood the test of time, as menstrua or solvents in which to dissolve the copper, being potassic cyanide and some combinations of this remarkable salt with ammonia and ammoniacal salts. Practical working, however, soon showed that one difficulty was overcome, but others of an important nature were introduced.

The small solubility of copper compounds in potassic cyanide, the weak action of the solution upon the anode, the small electrical conductivity of this class of metallic solutions, and the strong disposition to evolve hydrogen gas during deposition are the most important of the drawbacks to the successful working of alkaline copper solutions to coat iron. All these peculiarities have been lessened or overcome, to a certain extent, for more than fifteen years past, excepting the last—the evolution of hydrogen. The price at which they have been overcome, however, is almost suicidal to success. The action of heat upon the solution is not only to increase its solvent power, and its electrical conductivity, but also to somewhat increase the expense and trouble of working the process. An increase in the number of cells of which the battery is composed, or of the electro-motive force, acts in a similar manner to heat in regard to the solvent power and electrical conductivity of the solution this, however, not only largely increases the expense, but tends to overcharge the solution and to produce a brittle deposit that is also spongy, the sponginess or initiative tree-like formation arising from the evolution of hydrogen gas during deposition. Nevertheless, by the combination of these two agents, heat and increased electro-motive power, the solution of cupric cyanide in potassic cyanide is enabled to deposit copper upon iron in a form which is barely marketable, but which is obliged to be varnished, and then has scarcely the metallic appearance of a good application of bronze powder.

The evolution of hydrogen gas during deposition is not a difficulty that the early workers in electro-metallurgy would have anticipated, for (with the exception of the cyanide silver solutions) it did not occur to them to employ other salts than those of the metal to be deposited. When, however, the salts of the alkaline metals are employed, instead of the simple acids or hydric salts, as solvents for the metals to be eliminated from a given solu-

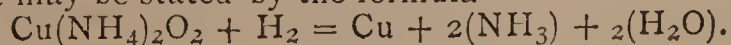
tion by means of electrolysis, the disposition of the metal of the alkali to go to the negative pole along with the metal dissolved in it, renders the alkaline solutions prone to evolve hydrogen from the decomposed water of the solution.

The prevention of the evolution of hydrogen gas from the cathode lessens the amount of electro-motive force required and tends to the formation of a solid deposit, and one that does not consist merely of a very fine network but is continuous over the whole surface covered, it also tends to preserve the solution in the normal condition and to improve the quality of the metal. A remark from Dr. Miller, of King's College, to the writer, led to the discovery of a method of working without the evolution of hydrogen, and Dr. Frankland, of the Royal College of Chemistry, suggested to him (the writer) a means of carrying out that method which ultimately proved to be practical. This method, consists in supplying to the ordinary cyanide solution, or to a solution set forth in the Patent Specification No. 1540 (A.D. 1857), after the cyanide of copper is dissolved therein to the proper extent, the hydrated oxide of copper in a wet state, in small but sufficient quantity; as a means of adjustment and absolute prevention, the blue or purple ammoniuret of copper may be added.

When the cyanide of a fixed alkali and a salt of ammonia are mixed to form an electrolytic solvent solution, the resulting solution, with some exceptions, is found to have the remarkable property of dissolving a brass anode and of giving up the brass to a cathode (of cast- or wrought-iron for instance), in a tolerable reguline form, but with the copious evolution of hydrogen gas, the proportions of copper and zinc in the resulting alloy being dependent upon the heat of the solution and also influenced to some extent by the electro-motive force and by the relative size (area) of the anode and cathode.

Having tried many of these cyanogen compounds, the writer has found a mixture of potassic cyanide and ammoniac tartrate to give the best results and the least evolution of hydrogen; the addition of the wet hydrated oxides of the metals however, and especially of the ammoniuret of copper, entirely removes the tendency to the evolution of hydrogen. This combination of the solvent solution is treated of in Patent Specification No. 1540 (A.D. 1857), and the method of preventing the evolution of hydrogen in No. 3930 (A.D. 1868).

The action of the ammoniuret of copper in stopping the evolution of hydrogen, appears to be that of carrying oxygen to the cathode and thus enabling the hydrogen that would otherwise be evolved to unite with a sufficient proportion of oxygen to form water and to continue in solution. Upon this supposition, which is merely put forward as a suggestion, the ammoniuret of copper, as a whole, acts as a cation which, when it arrives at the cathode, is itself decomposed into metal, ammonium, and oxygen. According to this idea, the action which takes place may be stated by the formula





The best containing vessel for the copper or brass solution is a wrought-iron tank with a steam jacket and suitable fittings to it.

Articles of wrought-iron or steel are comparatively easy to electro-coat, care being taken to select good material, well puddled and free from scales or scorizæ. The metal is taken from the workman's hands, if greasy, it is immersed for a few minutes in a boiling solution of caustic potash—one part of potash to ten parts of water—it is preferable, however, to keep grease away from articles that are to be electro-coated. It is then washed in running water and pickled in a bath containing one part by measure of oil of vitriol to twenty parts of water; this operation should not continue longer than is necessary to thoroughly free the iron from scale and to expose the absolute metallic surface. The heat at which the electro-depositing bath is used serves to finally cleanse the surface of the article (which should be washed before immersion therein), and promotes the adhesion of the deposit, it is well, therefore, to allow the articles that make up a charge for a bath to remain in a short time before completing the electrical circuit. At first the electric power should be small and it may be increased as the coating proceeds. The completed articles may be washed and well rubbed with hot mahogany sawdust, being allowed to remain therein for some hours.

Cast-iron is, perhaps, the most difficult substratum on which to build up an electro-deposit, but with care and by the selection of good material, the above-mentioned solutions furnish good results. The casting, trimmed, direct from the foundry, is pickled as above, washed, and well scrubbed with sand and water until its true metallic lustre appears in all its parts, it is then coated with copper in the alkaline copper bath, and when well covered, is removed to the electro-brassing bath, unless it is desired to copper it only. The operations require greater attention than those for wrought-iron and the final washing and drying should be thoroughly performed.

By this process, one Smee's cell may be used; six were originally requiring for electro-brassing. The cost has been found to be about 2s. 6d. per lb. of metal deposited. One ounce and a half of copper or brass per square foot will protect iron from rust.

A separate bath should be used for wrought and cast-iron, and even for different qualities of cast-iron. Order, cleanliness, and well-trained manipulation, in this department of applied chemistry, ensure success.

74, Brecknock Road, London, N.,  
June, 1870.

### ON CYCLOPIC ACID,

A NEW FLUORESCENT SUBSTANCE EXTRACTED FROM THE  
CYCLOPIA VOGELII.\*

By ARTHUR H. CHURCH, M.A. Oxon, F.C.S.

ONE of the plants used by the African Boers, for tea, is the *Cyclopia Vogelii*. Endeavouring to extract theine from the dried leaves and flowers of this plant, I met with a substance apparently new to science, and possessing one remarkable property, that of a high degree of fluorescence. This character is best seen when a crystal or two of the new body is dropped into a solution of caustic soda and viewed in sunlight. An intense greenish yellow fluorescence is perceived at first, but disappears in the course of some hours.

I have named the new substance *cyclopic acid*. It is extracted by enclosing a pound or so of the dried leaves in a cloth, and immersing this for some days in water at about 30°–40° C., occasionally squeezing the cloth. A yellow powder gradually accumulates at the bottom of

the vessel of water, and should be dissolved in a mixture of ether, alcohol, and water, acidified with a drop of acetic acid. By two or three re-crystallisations from weak alcohol, the cyclopic acid is obtained pure. It contains only carbon, hydrogen, and oxygen; different samples gave closely accordant results on analysis—

	Percentages of Carbon.	Percentages of Hydrogen.
1.	53.43 .. ..	5.78
2.	53.58 .. ..	5.92
3.	53.40 .. ..	5.13
4.	53.36 .. ..	5.62

These numbers correspond pretty fairly with the formula  $C_7H_8O_4$ , which demands the following percentages:—

Carbon .. ..	53.84
Hydrogen .. ..	5.13
Oxygen .. ..	41.03
	<hr/> 100.00

The formula,  $C_7H_8O_4$ , is rendered more probable by the result of neutralising cyclopic acid with a standard solution of ammonia. The formula indicated for the ammonium cyclopate thus produced was  $C_7H_6[NH_4]_2O_4$ .

It is possible, however, that cyclopic acid contains more hydrogen than assumed above, in which case it would have the formula  $C_{14}H_{18}O_8$ , and its ammonium-salt be  $C_{14}H_{14}(NH_4)_4O_8$ .

### ON THE

### ESTIMATION OF FERROUS OXIDE, IN PRESENCE OF FERRIC OXIDE, IN SILICEOUS MINERALS.\*

By CHARLES A. WILBUR and WALTER WHITTLESEY,  
Students in the Massachusetts Institute of Technology.

AT the suggestion of Prof. Storer, we have applied the observation of Avery† to the estimation of ferrous and ferric oxides in silicates. Avery found that silica and many silicates can be readily and completely dissolved by a mixture of some normal fluoride with almost any of the stronger acids, whether concentrated or dilute. He has promised to work out a method of determining all the constituents of a silicate in a single portion of the mineral after having dissolved it in a mixture of fluoride of barium, fluoride of lead, or the like, and nitric or chlorhydric acid.

We have confined ourselves to the estimation of the two oxides of iron, and have obtained satisfactory results so easily that we are led to hope and believe that our process will be found worthy of being generally adopted for the estimation of iron in silicates. Our method is as follows:—

A quantity of the finely-powdered silicate to be examined is weighed in a platinum crucible; as much, or rather more than as much, powdered fluor spar, free from iron (or of powdered cryolite), is poured into the crucible; the powders are thoroughly mixed by stirring with a glass rod; the rod is wiped clean upon a fresh portion of the powdered fluoride; and the latter is thrown upon the mixture in the crucible. Strong chlorhydric acid is then poured into the crucible, until the powder is thoroughly drenched and the crucible about two-thirds filled with the liquid. The crucible is set upon a water-bath, and heated until the iron has all dissolved; and the proportion of iron is finally determined by titrating with a standard solution of permanganate of potassium in the usual way. To protect the mineral from the air during the process of solution, the crucible must be kept full of some non-oxidising gas, which can be either carbonic acid or coal gas, as may happen to suit the convenience of the operator.

\* Communicated by the Author. From the Report of the Chemical Department, Royal Agricultural College, Cirencester.

\* Communicated through the kindness of Professor Storer.  
† CHEMICAL NEWS, vol. xix., p. 270.



If carbonic acid be used, it is sufficient to cover the crucible with a bit of sheet-lead, perforated with two holes, through one of which is thrust a glass tube communicating with a gas-bottle in which the carbonic acid is generated, while the other serves as an outlet for the escape of carbonic acid and acid vapours. The crucible is, in this case, simply set upon an ordinary water-bath.

When coal-gas is used (and this agent is to be preferred on the whole), the apparatus may be arranged as follows:—Set the charged platinum crucible upon a glass or leaden tripod inside a wide beaker in the bottom of which there is about an inch of water. Invert a narrower beaker within the first, so that its mouth shall be sealed by the water and the crucible be enclosed in a transparent chamber. Coal-gas is led into this chamber through a bent glass tube, which passes down between the side of the upright and that of the inverted beaker, and delivers the gas near the top of the chamber. The surplus gas escapes through another tube, similarly bent, which starts from a point below the crucible, and is burned in the outer air.

To facilitate the passage of the glass tubes, the mouth of the inverted beaker may be made to rest upon three or four bits of stone or metal, or an orifice large enough to admit the tubes may be made upon the rim of the beaker.

During the process of solution, the upright beaker is kept immersed in water, at or near the temperature of boiling. In case the coal-gas should contain any sulphuretted hydrogen, it would be well to purify it by means of a potash-tube.

We have made numerous experiments to test the accuracy of the process and determine the time needful to effect the decomposition of an ordinary silicate. After we had found, by experiments, that simple mixtures of fluor spar and acid, which had been heated for an hour or two on the water-bath, exerted no decolourising action upon the permanganate, we proceeded to compare such mixtures with those which, besides the fluor spar and acid, contained weighed quantities of fine iron wire.

The results of this series of experiments are as follows:—

## WHITTLESEY.

	Weight of iron wire taken.	C.c. of chameleon used.	C.c. of chameleon calculated on 0.2 grm. of iron.
1. { Iron wire with fluor spar ..	0.1330 ..	19.30 ..	29.02
"   without fluor spar ..	0.1290 ..	18.80 ..	29.22
2. {     "   with fluor spar ..	0.1010 ..	14.70 ..	29.20
"   without fluor spar ..	0.1010 ..	14.70 ..	29.20
3. { Iron wire with fluor spar			
"   which had been ignited..	0.1268 ..	18.40 ..	29.02
Iron wire without fluor spar	0.1268 ..	18.25 ..	28.78

## WILBUR.

	Weight of iron wire taken.	C.c. of chameleon used.	C.c. of chameleon calculated on 0.2 grm. of iron.
Iron wire with fluor spar ..	0.2450 ..	36.37 ..	29.67
"   "   " ..	0.1680 ..	24.45 ..	29.11
"   "   " ..	0.1680 ..	24.50 ..	29.29
"   "   " ..	0.1940 ..	28.60 ..	29.48
"   "   " ..	0.1940 ..	28.75 ..	29.63
"   "   " ..	0.1630 ..	24.35 ..	29.87
"   "   " ..	0.1870 ..	27.35 ..	29.78
"   "   cryolite.. ..	0.1740 ..	26.50 ..	30.46
"   "   " ..	0.1620 ..	24.62 ..	30.40
"   "   " ..	0.1632 ..	24.87 ..	30.48
*     "   "   fluor spar ..	0.1810 ..	26.87 ..	29.69
* Sulphate of iron and ammonia	1.1989 ..	25.40 ..	29.66
* Iron wire with fluor spar ..	0.2290 ..	34.00 ..	29.69

\* Final experiments made to test accuracy of process.

We next proceeded to estimate the amount of protoxide of iron in a couple of specimens of trap-rock, A from the slate-quarry on Milk Street, near the Bleachery, and near Laurel Street, in Somerville, Mass.; and B, trap from west side of the slate-quarry near the Powder-House in Somerville; dip nearly vertical; strike about N. and S.

## TRAP A.

Amount of trap taken.	C.c. of chameleon used.	Per cent of FeO found.
0.9020 ..	11.2 ..	11.39
0.9300 ..	11.8 ..	11.64
0.8730 ..	11.2 ..	11.77
0.9120 ..	11.0 ..	11.03
0.3640 ..	5.0 ..	11.82
0.2867 ..	4.0 ..	11.95
0.5230 ..	7.0 ..	11.53
0.3957 ..	5.0 ..	10.87
0.5512 ..	6.0 ..	9.37
0.3730 ..	4.5 ..	10.39

## TRAP B.

Amount of trap taken.	C.c. of chameleon used.	Per cent of FeO found.
0.4850 ..	4.6 ..	8.21
0.6500 ..	5.4 ..	7.17
0.2848 ..	2.5 ..	7.68

The times of exposure to heat, upon the water-bath, of the mixtures of trap, acid, and fluor spar differed widely in the different cases.

We find that an hour and a half is ample for the solution of the iron in 0.5—1 grm. of the finely-powdered trap. Fifteen minutes, on the other hand, will suffice for the solution of 0.2 grm. of iron wire.

Instead of chlorhydric acid, sulphuric acid may be used to act upon the mixture of fluor spar and trap, as was done in the third and fourth experiments of the foregoing list, trap A. The sulphate of calcium formed in this case is objectionable, from its liability to envelope portions of the mineral and to protect the iron from being dissolved, rather than from any tendency to interfere with the actual titration.

Experiments were next made to determine whether the presence of sesquioxide of iron could interfere in any way with the estimation of the protoxide.

Commercial iron-alum, which of itself had no decolourising action on chameleon, had none after it had been heated with cryolite and chlorhydric acid. It was found, also, by acting upon weighed quantities of iron wire mixed with cryolite and iron-alum, that the iron can be estimated as well in the presence of the alum as in its absence, provided only that the metallic iron be dissolved in chlorhydric acid, with the necessary precautions to prevent oxidation, before adding the other ingredients of the mixture. If the iron wire, cryolite, and ferric alum were treated all at once with acid, some of the hydrogen generated by the solution of the metallic iron would reduce a part of the ferric salt; so that, in the final titration, more iron would be found than was introduced into the mixture in the form of wire.

To determine whether ferric oxide which had been strongly ignited could be dissolved by the process in question, one of us heated a couple of samples of the ignited oxide with fluor spar and chlorhydric acid during three or four hours, upon a water-bath. The dissolved iron was then reduced with zinc, and titrated with chameleon.

In the first experiment, the ferric oxide was in the form of small lumps; in the second it was powdered.

Weight of Fe <sub>2</sub> O <sub>3</sub> taken.	C.c. of chameleon used.	Per cent of Fe found.	Theory requires per cent.
0.1175 ..	6.37 ..	36.35 ..	70.00
0.1172 ..	12.10 ..	69.17 ..	70.00

It would appear that, if time enough be allowed, finely-powdered ferric oxide can be dissolved in this way, even after intense ignition.



To estimate ferric oxide in a silicate, a separate portion of the mineral may be treated with fluor spar and acid, the solution reduced by zinc in a small flask in the usual way, and the total amount of iron determined with chameleon. Or, if the mineral contains only a small proportion of ferric oxide, it will be sufficient to put a bit of zinc into the crucible with the mixture of mineral, fluor spar, and acid. The difference between the total iron and that determined as ferrous oxide is calculated as ferric oxide.

Two samples of trap A dissolved as above, with the addition of metallic zinc to the crucible, gave:—

	I.	II.
Weight of trap taken ..	0.285	0.4052
C.c. chameleon used ..	5.000	7.0000
Per cent of FeO* found ..	15.110	14.8800

We also fused two samples of the same trap with carbonate of sodium, dissolved in chlorhydric acid and water, and reduced with zinc in a flask.

	I.	II.
Weight of trap taken ..	0.4783	0.6849
C.c. chameleon used ..	8.3700	12.2500
Per cent of FeO* found ..	14.7500	15.0600

Two samples of impure iron-alum, dissolved in chlorhydric acid, and afterwards reduced with zinc in a flask, gave:—

	I.	II.
Weight of alum taken ..	1.2462	1.486
C.c. chameleon used ..	17.2500	20.120
Per cent of Fe <sub>2</sub> O <sub>3</sub> found ..	12.9500	12.670

Two samples of same alum, treated in crucible with cryolite and acid in the same manner as the trap, and afterwards reduced in a flask with zinc, gave:—

	I.	II.
Weight of alum taken ..	0.8505	0.8465
C.c. chameleon used ..	12.0000	11.6000
Per cent of Fe <sub>2</sub> O <sub>3</sub> found ..	13.1900	12.8500

Boston, April, 1870.

#### ON SOME CIRCUMSTANCES WHICH FAVOUR THE SIMULTANEOUS PRECIPITATION OF ALUMINA AND MAGNESIA BY AMMONIA.

By LAURENCE F. J. WRINKLE,  
Student in the Massachusetts Institute of Technology.

It was observed, long ago, by Abich (*Poggendorff's Annalen*, 1831, xxiii., 352), that the alumina precipitated by ammonia from mixed solutions of aluminum and magnesium salts, may hold considerable quantities of magnesia in insoluble combination; and that the whole of the alumina cannot be dissolved from such precipitates by boiling with caustic lye. The observation has been repeatedly verified, in the laboratory of the institute, by students who have endeavoured to analyse a mixture of Epsom salt and potash alum by the second of the methods laid down by Galloway, on page 86 of his "Manual of Qualitative Analysis," (London, 1864). It is there directed to dissolve, in the smallest possible quantity of boiling dilute chlorhydric acid, the precipitate produced by ammonia in the boiled filtrate from the precipitate produced by sulphuretted hydrogen, in the ordinary course of analysis, and to add to this acid solution, when cold, a cold solution of soda or potash. The purpose of the alkali is to bring the aluminum and chromium, if any there be, into solution, while iron is left behind. But in the case of the mixture above-mentioned, the alumina fails to dissolve in the alkali. An insoluble compound of aluminum and magnesium is left, to be mistaken, perhaps, for iron.

I have, myself, repeated the experiment by adding ammonia to the solution of a mixture of alum, Epsom

salt, and chloride of ammonium, and then boiling the precipitate with caustic soda for a couple of hours, after it had been collected and washed. On washing and testing the large portion of the precipitate which remained undissolved by the soda, I found that it contained an abundance of alumina.

Abich supposed the precipitate to be a mere compound of alumina and magnesia, like the mineral spinel, and proceeded to support this view by the following experiment:—Having weighed out quantities of alum and Epsom salt in such proportions that the oxygen ratio of the alumina to the magnesia was as three to one, he dissolved each of the salts in water, and treated the solution of sulphate of magnesium with so much chloride of ammonium, that the liquid no longer became cloudy on the addition of ammonia. He then added this magnesium mixture to the alum solution, saturated the whole with ammonia, collected the precipitate upon a filter, and tested the filtrate for magnesium. Since scarcely a trace of that element could be found in the filtrate, he, naturally enough, concluded that the magnesia had been precipitated by virtue of its affinity for alumina.

Abich's conclusion that a more or less definite aluminate of magnesium may be formed by precipitation, even in presence of chloride of ammonium, would seem to be supported, moreover, by his own analogous experiments on the precipitation of magnetic oxide of iron, in the wet way (*loc. cit.*, p. 353), and by the recent observations of Nichols (*American Journal of Science*, 1869, vol. xlvii., p. 16), "On the Precipitation of Insoluble Chromites of Magnesium by the Addition of Ammonia to Mixed Solutions of Salts of Magnesium and Chromium."

On examining into the matter, however, by direct experiment, it does not appear that the foregoing conclusion is justifiable. On the contrary, I find, in conformity with the statement of Fresenius ("Quantitative Analysis," London, 1865, p. 369), that it is possible so to precipitate the alumina by ammonia from a mixed solution of aluminum and magnesium, highly charged with chloride of ammonium, that no magnesium, or only an insignificant trace of it, will be dragged down.

It is noteworthy that the manner in which the ammonia is added to the solution has an important influence on the composition of the precipitate. I find, moreover, that far more magnesia will be dragged down by the alumina in case the solution contains a sulphate than if no sulphuric acid be present.

If the mixed solution of alumina and magnesia, charged with chloride of ammonium, be completely free from sulphuric acid, and if the ammonia water is added drop by drop to the hot solution (with constant stirring) until it is slightly in excess, the hydrate of aluminum thrown down will be entirely free from magnesium, or, at the most, will retain only a slight trace of that element. But if, on the other hand, an excess of ammonia be poured into the mixed solution rather quickly, a considerable quantity of the magnesia will go down with the alumina, even when no sulphuric acid is present.

If the solution contain the aluminum and magnesium in the form of sulphates, I find that as much as two equivalents of magnesia may be carried down by each equivalent of alumina, in case the ammonia is poured quickly into the solution. Probably a considerable larger proportion of magnesia could be thus dragged down by alumina from liquids more highly charged with the magnesium salt than mine were. But if the ammonia be added slowly, drop by drop, to the mixed sulphates of aluminum and magnesium, no more than 1 or 2 per cent of magnesia will be found in the dried precipitate.

I believe that if sulphuric acid be excluded, and the directions given by Fresenius for precipitating alumina by ammonia (*loc. cit.*, pp. 169, 369), be strictly followed, the precipitate may always be obtained practically free from magnesia.

A solution free, or nearly free, from sulphuric acid, was prepared for use in the foregoing experiments by precipi-

\* Calculating all the iron as ferrous oxide.



tating a dilute (but as I would believe, not sufficiently dilute) solution of ammonia-alum (containing 1.3 grms. of  $\text{Al}_2\text{O}_3$  to 750 c.c. of water) with ammonia, dissolving the washed precipitate in chlorhydric acid, and again precipitating, washing, and dissolving in the acid. The final solution of chloride of aluminum still contained a trace of sulphuric acid, but was thought to be pure enough for use.

To test the influence of the rapid addition of ammonia upon the amount of magnesia precipitated from solutions free from sulphuric acid, several quantitative determinations were made, with the following results:—To 50 c.c. of the above-mentioned solution of alumina in chlorhydric acid, containing 0.2575 grm.  $\text{Al}_2\text{O}_3$ , there was added 0.1 grm. of pure, dry magnesia, so that the proportion of  $\text{MgO}$  to  $\text{Al}_2\text{O}_3$  should be as 1:1, and about 5 grms. of chloride of ammonium. The solution was diluted to the volume of about 700 c.c., heated to boiling, and a considerable excess of ammonia water was quickly poured into it. The filtrate from the well-washed precipitate was evaporated to a small bulk, and the magnesia contained in it was precipitated by diphosphate of sodium. In the filtrate there was found 0.0854 grm. of  $\text{MgO}$ . Hence it appeared that  $0.1 \div 0.0854 = 0.0146$  grm. of  $\text{MgO}$  had been carried down by the alumina. In two other experiments, performed in the same way 0.0798 grm. and 0.0964 grm.  $\text{MgO}$  were found in the filtrates. Magnesia was detected also in each of the three alumina precipitates:

The following experiments, on the other hand, were made with mixtures of Epsom salt and ammonia-alum. The solutions were made in each case by dissolving 1.23 grms. of Epsom salt and 2.2675 grms. of ammonia-alum, respectively, so that the proportions of alumina and magnesia in each mixture should correspond to the formula  $2\text{MgO}, \text{Al}_2\text{O}_3$ .

I. Four solutions were made by dissolving the above quantities of alum and Epsom salt, together with 10 grms. of chloride of ammonium, in 750 c.c. of water; the solutions were heated to boiling, and to two of them ammonia-water was added, drop by drop, to slight excess, with constant stirring; while to the other two a considerable excess of ammonia was added, all at once, before the mixture was stirred. All four mixtures were filtered as soon as possible after the addition of the ammonia. After ignition, the first pair of precipitates weighed, respectively, 0.2581 grm. and 0.2641 grm.; the other pair weighed 0.4965 grm. and 0.491 grm. On adding disulphate of sodium to the filtrates from the first pair of precipitates, copious precipitates were produced immediately; but with the filtrates from the second pair it was only after standing over night that slight crystalline precipitates of phosphate of magnesium and ammonia could be detected upon the sides of the beakers. It should be remarked that the experiments in this paragraph were made subsequently to those in paragraphs II. and III.

II. A number of solutions made by dissolving alum and Epsom salt (taken in the above mentioned proportions) in about 400 c.c. of water, were mixed with large quantities of chloride of ammonium, and then heated to boiling and precipitated by the addition of a considerable excess of ammonia, added without special care or forethought. After ignition in a platinum crucible over a plain Bunsen burner, the precipitates weighed, respectively, 0.36 grm.; 0.5232 grm.; 0.5499 grm.; and 0.521 grm.; while the sum of the weights of  $\text{Al}_2\text{O}_3$  and  $\text{MgO}$  in the solutions taken amounted to only 0.4575 grm. Whence it appeared that some sulphuric acid is apt to go down with the alumina and magnesia. Abich himself (*loc. cit.*, p. 319), noticed a somewhat similar precipitation of sulphuric acid in conjunction with alumina and magnesia, and it is well known, for that matter, that some sulphuric acid is readily retained by alumina. H. Bley (*Journal für Praktische Chemie*, 1846, vol. xxxix., pp. 1—23), has, in fact, shown by quantitative experiments, that large amounts of sulphuric acid may be

dragged down by the alumina precipitated from solutions of alum.

It is to be observed, for the rest, that Abich, in his experiment of precipitating alumina and magnesia in equivalent proportions, operated with solutions of the sulphates of these substances. As now appears, it is hardly possible that he could have arrived at his erroneous conclusion if the solutions upon which he experimented had been free from sulphuric acid.

III. Seeking to avoid, if possible, this carrying down of sulphuric acid, I made other experiments, in which 10 grms. of chloride of ammonium and 750 c.c. of water were used in conjunction with the alum and Epsom-salt. The first precipitate obtained from such mixtures weighed 0.4567 grm., and the next 0.4754 grm., after long-continued heating over a plain Bunsen burner. In order to gain some idea of the proportion of sulphuric acid in this second precipitate, it was repeatedly heated over a gas blast-lamp for periods of ten or fifteen minutes, with the following results:—Weight of precipitate after plain Bunsen burner, 0.4754; after first blast, 0.4434; after second blast, 0.4334; third, 0.4317; fourth, 0.4314.

On a third trial, where the ammonia happened to be added strongly, the precipitate weighed only 0.255 grm. Since the pure alumina in the mixed solution amounted to 0.2575 grm., I was led by this remarkable result to make the experiments which have been recorded above, in paragraph I.

It is noteworthy that the appearance of the precipitates produced by the quick addition of ammonia is dissimilar according as they are obtained from solutions free from, or charged with, sulphates. The precipitates thrown down in this way from solutions of alum and Epsom-salt are dense and very difficult to filter; while those obtained from solutions of chlorides resemble ordinary precipitated hydrate of aluminum.

Before I had satisfied myself that it is easy to precipitate alumina almost free from magnesia by the method above described, I made several attempts to estimate the proportion of aluminum and magnesium in these insoluble basic sulphates, without, however, obtaining any very satisfactory results. The method of analysis employed was that of Deville (*Journal für Praktische Chemie*, vol. lx., 9), based upon the decomposability of nitrate of aluminum at a moderate heat. This process seems to yield good results when properly applied; but I experienced some trouble with it at first, from attempting to operate upon the mixed precipitate after it had been ignited. The ignited precipitate is scarcely at all soluble in hot concentrated nitric acid, even when the acid is made to act upon it for a long time; and it is not altogether easy to obtain a good separation of the magnesia and alumina after the precipitate has been made soluble by fusion with an alkali. The ignited precipitate can, of course, be dissolved in nitric acid after fusion with caustic or carbonated alkali; but, for my own part, I prefer not to ignite. The best way is to dissolve the moist precipitate immediately in nitric acid, to determine the alumina and magnesia in it, after Deville's directions, and to estimate the magnesia in the original filtrate for the sake of control.

I tried to decompose the ignited precipitate by fusion with nitrate of potassium, but abandoned the process on account of the risk of some material being carried off by the gases which are evolved as the nitrate decomposes.

When a very small quantity of the ignited precipitate was heated intensely with carbonate of calcium, over a blast-lamp, it became easily soluble in nitric acid; but, when as much as 0.3 to 0.4 grm. of the precipitate was operated upon, I could not obtain complete solution in this way. In using Deville's method, care should be taken to obtain nitrate of ammonium which is entirely free from non-volatile substances.

In attempting to analyse the mixed precipitate of alumina and magnesia obtained from Epsom-salt and alum, I was continually annoyed by the circumstance



that small quantities of alumina were dissolved, together with the nitrate of magnesium, by the solution of nitrate of ammonium. But I now suppose that this soluble alumina was derived from some of the basic sulphate in the precipitate, which had escaped decomposition when the precipitate was ignited.

Boston, April, 1870.

## THE FIRE ALARM TELEGRAPH OF NEW YORK CITY.\*

THE Fire Alarm Telegraph is designed, first, to enable any person to send a quick reliable telegraph message to the Central Station, indicating the existence of a fire near the spot from which the message is sent; and secondly, to enable the receiver of such a message to report instantly to as many other stations (the most important of which, of course, is the engine houses) as may be deemed advisable.

It is essential to the useful working of such a system that it should be always ready to respond instantly to the demands upon it; that the message sent should be positively reliable; that the condition of the out-door structure should at all times be under complete inspection of the Central Office; that an ordinary injury to the out-door structures may be instantly known and quickly repaired; that this injury, if not extensive may be of no serious detriment, and that a printed record of the transactions of the day, and the fidelity of those in charge, shall be produced. Such are the requirements of a perfect fire telegraph. How they are met will require an explanation in full detail of the construction, the machinery, and their varied combinations.

### *Lines.*

These are so built that only a few stations are embraced in each, and they are so interwoven that contiguous stations are upon different lines, so that an injury to one line, which might put one station out of order, would have no effect upon the next nearest station—because that one would be placed in connection with a distinct and separate line. The wires are very strong, and of unusually high conductivity, so that the currents of electricity may flow through without impediment. The various lines extending from the Battery to Spuyten Duyvil all finally converge at the Central Office; one end of each of the 56 coming in from the North and the other end of each from the South. They leave the tall poles in front of the head-quarters, and are conducted carefully over its roof and down to heavy spars, whence they pass directly into the office. Here they are continued systematically to the batteries and instruments, but are so coloured as to designate the particular office which each has to serve.

### *Instruments.*

The instruments and appliances at the Central Office consist of batteries, switch-board, register or receiver, indicator, transmitters, clock, repeater, and testing apparatus. The apparatus outside of the Central Office consist of automatic street signal boxes and mechanical gong strikers. All of these instruments are of the most perfect and elaborate construction, and most of them especially invented, designed, and made for the service of the complete system.

### *Batteries.*

These are compactly arranged in series of shelves, so as to be easily accessible. The shelves and stands are very thoroughly insulated, and the peculiar form of the battery keeps it perfectly clean and dry. The zinc element of this battery is so formed as to make a cover to the glass jar, and thus prevent evaporation and the introduction of

foreign matter in the interior. All batteries give off currents of electricity of various power, according to the amount of chemical substances destroyed—but they are almost universally constructed so that the plates are plunged into a reservoir of acids or chemicals, which act directly upon the plates, unless labour is expended upon them to keep them protected, or upon the other parts of the battery to keep them clean. There is thus a large amount of destruction of material independent of that due to the evolution of electric force. This destruction is called local action. If this abnormal action can be guarded against, two beneficial results ensue—economy of material is secured and constancy of electric force and incidental labour is saved. The constancy of force is a very great consideration in a system where, for the first time, is introduced apparatus for the exact and instant measurement of electric force on every line. The experiments to secure this evenness of power and small consumption of material were carried on for more than a year upon the old lines of the New York fire telegraph. For more than twelve months a steady current was supplied by means of these batteries—the only labour required being the occasional supply of crystals. Without describing any other features of the battery, it may be simply said that the principle of the long endurance is found in the arrangement by which a steady but minute supply of active chemical is supplied continually; the supply is regulated to the requirements of the line. Only one-tenth of the expenditure of chemicals and labour are required. As it has been considered the best policy to keep the entire system of lines in a state of continuous and simple inter-communication, and as the expense of sustaining such batteries has been so much reduced, a very large number of cups are maintained, which, if extended, would occupy nine hundred feet in length. Beside these batteries others are provided for special purposes. The wires leading from these batteries are carried into the operating room symmetrically, and with a view to their easy and instant identification.

### *The Switch Board.*

In all cases where many wires carry electrical currents into offices it becomes necessary at times to change the direction of these currents—to transfer them from one wire to another for various purposes—just as an engine and train of cars are diverted from one track to another. The same name is given to these devices, viz., “switch.” When many wires are introduced, each requiring its switches for its various purposes, the assemblage is called a “switch-board.” That of the New York fire alarm is superbly mounted, is nine feet in length, and has upon it upwards of five hundred switches, each performing its own special duty—but also arranged and grouped together so that very many may be moved by one common impulse, as when it is required to convert certain series on the entire number of lines from receiving to transmitting lines. To prevent oxidation the rubbing surfaces are heavily coated with platina. This combination gives the operator in charge the power of instantly applying to each and every line the changes which will be described. Unlike ordinary telegraph lines, the wires of the fire alarm do not pursue their course from the Central Office to the most distant station, and then dipping into the earth, consign the electric current to it, to be carried through it to the point of starting—thus making the earth the conductor for the return current—but the currents of the fire alarm return by wires. They leave and return to the office in what are called “metallic circuits.” It is far better where lines are comparatively short to make the entire conductor metallic. If no connection is had with the earth in any part of the line, slight defects of insulation and contact with houses or poles do not seriously affect the working of the circuits. Exigencies occur when it becomes desirable to divide the lines for tests or repairs. Through the switch-board the operator turns his north end into the earth, with or without a battery; also the south end, with or without a battery; or, in case of the apparent

\* Communicated by Professor Morton.



weakening of the battery, as made evident by a little tell-tale instrument yet to be described, he has the power of testing the exact force of his battery either off or on the line. He can also instantly exchange his enfeebled battery for his choice of several fresh ones, and he may change the course of the current of either of these fresh batteries, or, finally, he may place any one or all the lines in communication with the "repeater," thus changing them from receiving lines to transmitting.

Usually it is desirable to send out alarms, not only to all the alarm stations—that is, the engine houses, &c.—but also back again to the signal boxes throughout the whole island. The change, therefore, of all the lines from "signal" (that is, those that give the first alarm to the Central Office) to "alarm" (that is, those that receive the alarm sent out from that office) can be effected by almost a single movement on the switch-board. In order to give simplicity and order to the arrangement of this instrument, each and every line has its series of switches for these various changes arranged in rows. Every switch has designated upon it, in raised letters, the office it performs. Each and every line is alike, and each is numbered. They are also divided in sections of eight lines, so that it becomes quite easy to refer to any line without loss of time. Immediately in connection with the switch-board is a series of

#### *Galvanometers.*

These are instruments which measure the force of current on the line by deflection of a needle. A few degrees indicate a weak current, and many degrees a strong one. It is thus a valuable register of the state of the line—for the normal condition of the line being twenty degrees, ten degrees would indicate that the battery was becoming weak, and forty degrees would indicate that the battery was becoming stronger, which could not easily occur, or else that resistance at the line was lessened, or that the current had found some short road easier for it to travel than through all the length of the line with its numerous magnets. This measurement by degrees would be only a partial indication of the state of things. Hence to every one of these galvanometers is added that which makes the test an exact one. The "resistance" of a circuit or line is that obstacle it presents to the free passage of the electric current. Through a short circuit of large wire a large volume of electricity will pass and exercise powerful force upon magnetic instruments. Through a long circuit of fine wire the reverse is the case. Suppose a line five miles in length has included in it ten magnets, each of them being furnished with wire a mile long—or, as it is called, a mile "resistance"—the whole resistance would then be fifteen miles; but, if the current, instead of passing through all this length, proceed only two miles, and through only five magnets, and then gets back again, it is evident that it meets with only seven miles of resistance instead of fifteen. Hence we can often locate a trouble if we know the exact resistance of a line and compare it with the normal resistance of that line when all is in proper working order.

The process of ascertaining the exact resistance is as follows:—The needle of the galvanometer is made to deflect by the influence of a long coil of wire placed under it. When the current passes through the coil in one direction the needle deflects to the left; but we may add another coil of exactly equal power, so wound and placed that the needle may be pulled (by equal current) just as strongly to the right. Now, if we give a chance to the current from the same battery to go around these two coils at the same time, just as much will flow through each, and the needle being pulled in two ways with equal force, it will stand at zero. Again, if we add resistance to the wire connected with one coil and none to the other, then a greater part of the current will take the short road, and the coil without resistance will pull the needle the strongest. Hence, if we have a known adjustable resistance connected with the second coil, and the first coil is

connected with the line, when we have so altered and increased or decreased the known resistance that it equals the line resistance, and the needle stands at zero, the line resistance, of course, equals the measured resistance exactly.

The very resistance of lines thus tested daily, and recorded in a book, will be a complete history of the state of such lines. The instrument which contains the coils of measured resistance wires, by a combination of which any desired length of resistance is thrown in is called a "rheostat." In the Central Office it is arranged unlike any other such instrument, so that the changes may be made almost instantly, and at the same time can be read off in decimal numbers, indicating miles and tenths of miles.

#### *The Register or Receiving Instrument.*

This is the apparatus by which are recorded all the alarms that are sent into the Central Office, and all the tests of the day and night. The currents from the lines do not immediately proceed to this machine, but through the usual intervention of the relay magnet, of which fifty-six, in very compact form, are arranged upon the register-table. These relays act upon the register, and also, at the same time, upon an electric annunciator, by which the number of the line is indicated. When a signal is communicated to the Central Office from a street box, the first operation the box performs is to disturb and break up the current that steadily flows through the line at all times, and holds the relay magnet steadily charged. This break discharges the little magnet, its lever falls back, and, in so doing, instantly performs four operations. First, it throws down into view the number of the line called into action; it causes a bell to be rung; it starts the register wheel-work into revolution, and it prints a dot in ink upon a broad band of paper, which is rolled through the machine. If this single action was all that took place a single dot would be printed on the paper, which would run out about three inches and then the revolution would instantly cease, but it can be arranged that the paper shall run only two inches, more or less, before it stops. As long, however, as the line continues to be active by sending off signals, just so long will the paper keep running—always stopping, however, two inches, more or less, as adjusted, after the very last impulse from the line. This paper roll is about ten inches wide. Fifty-six pens, actuated by fifty-six magnets, are arranged beneath it, so that each and every one may be brought to bear upon the paper. Each one is connected with a separate line. The pens are numbered to correspond with the lines, from one to fifty-six.

Suppose that the signal 256 is to be sent in. The street box which sends this particular signal is one of those connected with line No. 21. The operation, then, of the bringing that box into action is, first, to start the paper roll into movement, and to throw into sight No. 21, to call into action the twenty-first pen, which, with great exactness, prints the signal 256 in ink upon the paper five times, and then the paper stops itself two inches after the last printed dot. Thus every signal sent over any of the lines is printed upon this same roll of paper either day or night. But the paper also records clearly another signal, which is automatic. A very fine regulating clock is suspended on the wall of the office. Precisely at each hour on the beat of the first second a type corresponding with the hour of the day strikes upon the paper roll and prints it. In the daytime the hour figures are different from those indicating the night hours. At the same moment a small bell is started, ringing continuously, notifying the operator in charge that the hour has come, and that he must proceed to test all his lines, and print the record that he has done so upon the paper. His duty is then to open for an instant each and every key on each and every line. These keys being arranged in groups of eight, may be struck in groups or singly. The single touch of all these keys makes upon the register paper fifty-six dots corresponding with the fifty-six lines; and if no alarm of fire should come in to be recorded on the same paper, on



any one of the lines, then, at the commencement of the next hour, it would be printed in the same way as before on the paper, and another series of tests would be made. Thus, at the end of a day's operations the paper would show that, between the striking of every hour, day and night, every line had been tested and its good condition recorded upon paper: or, if its pen failed to make a record, explanation of the cause would be sought for and the difficulty obviated. Whatever fire might occur between any hours, would be also recorded in its appropriate place, and the paper thus becomes a record of the locality of every fire, the time that it occurred, and also the sound condition of all the lines. The clock which serves to actuate the printing of the hours upon the paper, can also be made easily, by the agency of certain switches, to strike the precise commencement of any hour upon each or all of the six hundred stations embraced in the entire system. In direct connection with this register, and its supplementary apparatus through the medium of the wires, are the

#### Street Boxes.

These boxes form, of course, a very important part of the apparatus of the system. They are fastened to the poles or engine-houses, and consist of an outer casing or house of iron, with the seal of the Metropolitan Fire Department on each, and a label covered with glass indicating to the public where the key which opens the box may be found. Every policeman is also furnished with a key, and every fireman, and the insurance patrol. When a fire occurs in the neighbourhood of a box, anyone who first obtains the key opens the outer box. Within it he perceives a second iron box, and, fastened to it, a handle to be pulled down. Printed directions are also visible, to guide in doing this simple thing in the right way, and also showing how it may be known that pulling the handle has been effective. The moment the opener of a box hears a response, he knows that his work is done. The officers in the department, who have keys for the inner box, to which the handle is fastened, discover, upon opening them, a third box, round, and tightly closed up from the air. On the outside of this third box is to be seen simply a brass arm, extending out to the right. This brass arm is fastened to the apparatus within the round box. The office of the pulling-down handle on the second box is to engage with and pull down this brass arm.

The action upon the arm winds up the machine within, which begins running down as soon as the brass arm is left free to move by the disengagement of the pulling-down handle.

Opening the round box (previously, however, removing the brass arm), within is found a very excellently finished piece of clock-work, driven by a spring, which is so attached outside of the frame that, if it breaks, another can be supplied without pulling the frame to pieces. The arm winds up the machine like a watch, but only a short distance. It begins to run down, and, in doing so, as the movement is controlled by a very perfect regulator, one of the wheels of the trains carries a "circuit-wheel," with teeth cut on it corresponding with the particular number-signal which the iron box represents. The office of the regulated clock-work is to carry this circuit-wheel very steadily and slowly around from one to five times, as it is set. Each time it revolves, its teeth strike upon springs, and the circuit is made to open and close correspondingly. Two teeth, a space, then three teeth and another space, and then four teeth and a long space, would cause the circuit to be opened and closed so as to ring out the number 234. As every box has a circuit-wheel with a different number, the starting of the machine of any box communicates its special number with certainty, five times repeated, to the Central Office, and it is printed on the paper of the register five times. In addition to this machine, the second box contains a magnetic bell, which rings in accordance with the signal sent, and thus becomes an indicator that the message is going correctly to the Central Office; it also receives the return signal from the

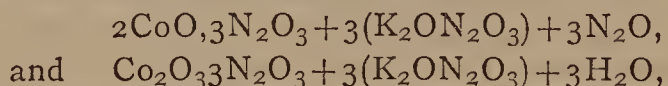
Central Office, and any and every desired signal which is sent out from that place. There is also a telegraph-key, by which messages, if necessary, may be sent; also a lightning-arrester; also a simple arrangement which, turned either right or left, divides the line into two parts, so that, if any accident should occur to interrupt the continuity of the circuit, preventing the current from going to or returning from the Central Office, the uninjured part of the line may be almost immediately utilised, and, instead of having ten boxes thrown out of use, the loss may be reduced to a single one. Thus a fire may burn down a pole or break a wire, but in a very few minutes the accident is known, and the line which has been broken is made into two short ones, until the time when it becomes practicable to re-unite the broken ends.

The other principal receiving-instruments in the Office consist of two extra and ordinary registers, by which the communications with the boxes which may be necessary for keeping the lines in perfect repair and good order are carried on, so as not to allow the main register to be cumbered by them. The apparatus for *sending out* the fire-signals, received from and through the machines just described, consist of the repeater, the supplementary repeater, and the mechanical gong-strikers.—*Journal of the Franklin Institute.*

### ON THE POTASSIO-COBALTIC NITRITE KNOWN AS FISCHER'S SALT, AND SOME ANALOGOUS AND RELATED COMPOUNDS.

By SAMUEL P. SADTLER.

THE composition of the double nitrate of cobalt and potash, known by the different names of "Fischer's Salt," and "Cobalt-yellow," has long been an open question. The following is a brief statement of the views advanced on the subject. Fischer,\* the discoverer of the salt, made no analyses of it. St. Evre,† who re-discovered it, gave as a formula for it  $K_2ON_2O_4 + CoON_2O_4$ , but does not give the analytical data. Stromeyer‡ subsequently showed the incorrectness of this view, and wrote the formula  $Co_2O_3 \cdot 2N_2O_3 + 3(K_2ON_2O_3) + 2H_2O$ . This formula is peculiar in making the atom  $Co_2O_3$  combine with 2 atoms of  $N_2O_3$ . We shall discuss the formula and results further on. Erdmann|| first pointed out a distinction between the salt formed in neutral solutions and the salt formed in acid solutions, which latter he considers as a normal salt. He gives both



or, as we shall write it,  $Co_26NO_2 + 6(KNO_2) + 3H_2O$  Braun,§ the last writer on the subject, passes most of the preceding work in review. He takes up Stromeyer's results, and rejecting his views as to the composition of the salt analysed by him, figures for it a number of ingenious but somewhat complicated formulæ. He considers that neither the "neutral salt" nor the "acid salt" of Erdman can be regarded as anything but mixtures or "poly combinations," and for the first of them considered as such, he gives a still more ingenious and complicated formula. We quote it as reduced to its empirical form by Blomstrand:¶  $Co_{62}K_{59}N_{112}H_{20}O_{454}$ .\*\* Braun's own results are expressed first by a formula containing both

\* Pogg. Ann., lxxii., 477, and lxxiv., 124.

† Fr. pr. Ch., 54, 84, and 58, 185.

‡ Ann. Ch. u. Ph., xcvi., 218.

§ Fr. pr. Ch., lxxiii., 598.

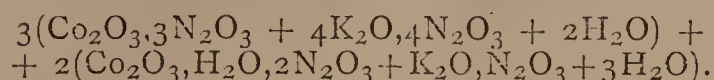
¶ Zeitsch. Anal. Ch., vii., 313.

¶ Chemie der Jetztzeit, p. 414.

\*\* Should be O 508.



$\text{Co}_2\text{O}_3$  and  $\text{CoO}$ , then by one containing  $\text{Co}_2\text{O}_3\text{CoO}, \text{N}_2\text{O}_3$  and  $\text{N}_2\text{O}_5$  and finally by the following:—



The experiments made to settle its composition and the results obtained are as follows:—St. Evre ignited the salt in a stream of nitrogen. Nitric oxide was given off and the residue was a black oxide, which, on contact with  $\text{HCl}$ , gave  $\text{Cl}$ , and with  $\text{C}_2\text{H}_2\text{O}_4$  gave  $\text{CO}_2$ . This I cannot regard as conclusive, as mere ignition *per se* will not break up the  $\text{KNO}_2$ , so that the residue was not pure,  $\text{Co}_2\text{O}_3$ ; moreover the  $\text{N}_2\text{O}_3$  in breaking up may have given an atom of  $\text{O}$  to form the  $\text{Co}_2\text{O}_3$ . Stromeyer found that  $\text{NaHO}$  and  $\text{BaH}_2\text{O}_2$  decompose it on gentle warming, even with exclusion of air, separating the brown hydrated  $\text{Co}_2\text{O}_3$  which dissolves in  $\text{C}_2\text{H}_4\text{O}_2$  with a brown, and in  $\text{C}_2\text{H}_2\text{O}_4$  with a green colour. This observation is of undoubted value. He says, also, that on mixing the neutral solutions, the precipitate is slow in forming, and forms by an absorption of  $\text{O}$ , as is shown by dipping the connecting tube under a cylinder of air or oxygen. Erdmann confines himself to an examination of this last observation of Stromeyer's, and finds that the "neutral salt" can be formed in an atmosphere of pure  $\text{CO}_2$ , and that therefore there can be no absorption of  $\text{O}$  in the case. Braun finds that  $\text{KHO}$  acts very little upon the salt, merely changing its colour from yellow to a dirty yellowish-green.  $\text{NaHO}, \text{BaH}_2\text{O}_2, \text{CaH}_2\text{O}_2$  separate, at a boiling heat, the brownish-black hydrated  $\text{Co}_2\text{O}_3$ ; this is confirmatory of Stromeyer's observation. Carbonate of silver heated with water and Fischer's salt, gave, with separation of the hydrated  $\text{Co}_2\text{O}_3$ , crystals of what, from Braun's description, were probably  $\text{AgNO}_2$ ;  $\text{KCy}$  did not decompose it.

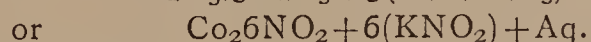
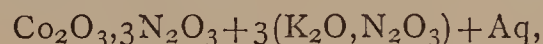
My own experiments directed toward the solution of the question of  $\text{CoO}$  or  $\text{Co}_2\text{O}_3$  were as follows:—I found Erdmann's observations as to the formation of the "neutral salt" in an atmosphere of  $\text{CO}_2$  correct. I added, by means of a funnel tube, a solution of  $\text{KNO}_2$ , boiled to expel the air, to a boiled solution of  $\text{CoCl}_2$ , placed at the bottom of a partially closed vessel, into which a strong stream of  $\text{CO}_2$  had been passing for some time. The salt began, nevertheless, to form slowly. Wishing to sift the matter more thoroughly, I made a series of experiments in eudiometer tubes over mercury. Into a eudiometer tube, filled with mercury and perfectly free from air, I threw up a boiled solution of  $\text{CoCl}_2$  and then one of  $\text{KNO}_2$ . The salt began to form soon at the juncture of the two liquids and then deposited steadily though slowly. After a number of hours not the slightest bubble of air was to be seen. The absence of all chance of oxidation here, either from air or excess of nitrous acid, shows, conclusively, the protoxide nature of this "neutral salt." The "acid salt" was formed in the same manner—first a boiled solution of  $\text{CoCl}_2$ , then acetic acid, and then a boiled  $\text{KNO}_2$  solution. A rapid evolution of gas ensues, and the salt forms and falls in a layer on the top of the mercurial column; in another instance a small crystal of  $\text{CoCl}_2$  was sent up, and then acetic acid, and then  $\text{KNO}_2$ . The formation of the salt was almost instantaneous, and the evolution of gas exceedingly rapid. Before drawing any conclusions from this, however, the action of acetic acid on  $\text{KNO}_2$ , out of access of air, was to be studied. Gmelin\* states that, when treated with acid out of access of air, nitric oxide is evolved, while the liquid takes up  $\text{NO}_2$  and  $\text{N}_2\text{O}_5$ . This evolution was found to take place readily over the mercury, and the gas answered to the test of ferrous sulphate, and was coloured red on admission of air, like the gas evolved in the formation of the salt. The question now is whether the liberated  $\text{O}$  is taken up in the formation of the salt to oxidise the  $\text{CoO}$ , to convert the excess of nitrite into nitrate. The question cannot be definitely settled until we have some delicate test for a small quantity of

nitrate in the presence of a large quantity of nitrite; but there is one thing which I regard as significant, Erdmann made one of his preparations of the "acid salt" by filtering the mixture of neutral solutions into pure acetic acid. Now the greater the excess of acid, the quicker would be the conversion of nitrite into nitrate, and we should look for a very small amount of the double nitrite salt. Yet it formed as readily, and analysis proved it to possess the same constitution as the other preparations. The inference from this is, that the sesquioxide-forming power of the  $\text{Co}$  is sufficient to enable it to take liberated oxygen.

Recourse was now had to analysis as a means of determining the question. Six distinct preparations of the salt in all were made and analysed. In preparing the salt, the distinction made by Erdmann in regard to the formation of different compounds in neutral and acid solutions, was recognised, and the salt was invariably formed in a solution, strongly acidified by acetic acid in the beginning, and kept so until the end by the addition of acid, if necessary. The salt of cobalt used was the chloride, and, in all but the first two preparations, the solution was boiled to expel air, and made acid. A strong solution of  $\text{KNO}_2$  was then added, and the mixture was left to stand; six or twelve hours generally proved sufficient, and it was then filtered and washed, according to Erdmann's direction, with a solution of potassic acetate of about 10 per cent, which was displaced by 80 per cent alcohol. The salt was then dried, first over the water-bath and then in a water-oven, exactly at  $100^\circ$ . I saw no evidence of a decomposition at this temperature alluded to by Erdmann.

The results of full analyses of these six preparations warrant me, I think, in presenting the following conclusions:—

1. That Fischer's salt is a *Tri-potassic-Cobaltic-Nitrite*, its essential formula being



2. That it can be formed with  $4\text{H}_2\text{O}, 3\text{H}_2\text{O}, 2\text{H}_2\text{O}, \text{H}_2\text{O}$ , or anhydrous, according to the degree of concentration of the solutions used, passing in colour from a light yellow to a dark greenish-yellow.

3. That in consequence of such dependence, we can, in most preparations, fix no absolute point, but are liable to have a mixture of salts of different degrees of hydration.

The analytical methods used in the analyses of the salt were the following:—

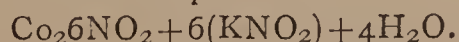
The  $\text{Co}$  was determined first together with the  $\text{K}$ , as a double sulphate having the invariable constitution  $\text{Co}_2\text{K}_6\text{SO}_4$ . This sulphate has a distinct fusing-point, and affords an accurate means of determination. It will be discussed further on. This is then dissolved, the solution made ammoniacal, and brought to boiling, when the  $\text{Co}$  is thrown down as  $\text{CoS}$ . This is roasted, and, after treatment with aqua regia and sulphuric acid, is weighed as neutral  $\text{CoSO}_4$ . Or the  $\text{Co}$  was thrown down from the solution of the double sulphates as peroxide by acetate of soda and chlorine, and then reduced by hydrogen to the metallic state.

The potash is then determined by difference.

The nitrogen was determined, either together with the  $\text{H}_2\text{O}$  by Gibb's modification of Bunsen's method, which will be again alluded to, or directly by volume with the Sprengel-pump.

The  $\text{H}_2\text{O}$  either as above, or by combustion with  $\text{Cu}$  in a stream of  $\text{CO}_2$ .

Prep. No. 1.



	Theor. p. cts.	Found p. cts.
$\text{Co}_2\text{O}_3$ .. ..	17.00	17.45
$\text{K}_2\text{O}$ .. ..	28.94	29.00
$\text{N}_2\text{O}_3$ .. ..	46.69	45.21
$\text{H}_2\text{O}$ .. ..	7.37	6.99



## Prep. No. 2.



	Theor. p. cts.	Found p. cts.
$\text{Co}_2\text{O}_3$ .. ..	17.32	17.77
$\text{K}_2\text{O}$ .. ..	29.48	29.70
$\text{N}_2\text{O}_3$ .. ..	47.57	47.22
$\text{H}_2\text{O}$ .. ..	5.63	5.43

## Prep. No. 3.



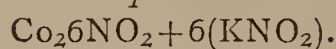
	Theor. p. cts.	Found p. cts.
$\text{Co}_2\text{O}_3$ .. ..	17.65	17.96
$\text{K}_2\text{O}$ .. ..	30.04	31.41*
$\text{N}_2\text{O}_3$ .. ..	48.48	47.87
$\text{H}_2\text{O}$ .. ..	3.83	4.15

## Preps. No. 4 and 5.



	Theor. p. cts.	Found p. cts.
$\text{Co}_2\text{O}_3$ .. ..	17.99	18.20 18.55
$\text{K}_2\text{O}$ .. ..	30.63	30.81 30.61
$\text{N}_2\text{O}_3$ .. ..	49.43	49.24 49.43
$\text{H}_2\text{O}$ .. ..	1.95	3.64† 3.92†

## Prep. No. 6.



	Theor. p. cts.	Found p. cts.
$\text{Co}_2\text{O}_3$ .. ..	18.35	18.58
$\text{K}_2\text{O}$ .. ..	31.24	31.90
$\text{N}_2\text{O}_3$ .. ..	50.41	51.21
$\text{H}_2\text{O}$ .. ..	—	0.75

It will be seen that, while the general coincidence is well sustained, there are several decided deviations. We can only call attention to certain facts in explanation. 1. We probably have in some of these preparations, mixtures of the salts of different degrees of hydration. 2. The salt cannot be purified by re-crystallisation. 3. The acetate of potash with which the salt is first washed is, as Rose† remarks, only removed with difficulty by the alcohol.

(To be continued).

## NOTICES OF BOOKS.

*First Principles of Chemical Philosophy.* By JOSIAH P. COOKE, jun., Erving Professor of Chemistry and Mineralogy in Harvard College. Pp. 560. London and Cambridge: Macmillan and Co. 1870.

THE author of this work, the Professor in the celebrated American University, states, in his preface, that the object of his book is to present the philosophy of chemistry in such a form that it can be profitably made the subject of college recitations, and furnish the teacher with the means of testing the students' faithfulness and ability. The subject has been developed in a logical order, and the principles of the science are taught independently of the experimental evidence on which they rest. It is assumed that the student has already been made familiar with the evidence and with the more elementary facts which the philosophy of science attempts to interpret. The book is divided into two main divisions. Part I. contains seventeen chapters, including, besides, a clear and lucid introduction giving definitions. The chapters treat on: Fundamental Chemical Relations; Molecules; Atoms; Chemical Notation: Stoichiometry; Chemical Equivalency; Chemical Types; Bases, Acids, and Salts; Chemical Nomenclature; Solution and Diffusion; Combustion; Molecular Weight; Crystalline Forms; Electrical

Relations of the Atoms; Relations of the Atoms to Light; Chemical Classification. Part II. is sub-divided into two main chapters, one of which bears title "The Perissad Elements," viz., hydrogen, fluorine, chlorine, &c.; the other "The Artiad Elements," viz., oxygen, sulphur, &c. The philosophy of chemistry is developed in this book according to the "modern theories;" careful attention has been given to chemical notation, and a method has been devised of writing rational symbols which, while it fully exhibits the relations of the parts of the molecule, condenses the formulæ, and saves space and labour in printing. The nomenclature usually current in our own Chemical Society has been adopted, but in the chapter on this subject the old names are given with the new. The metric system of weights and measures and the centigrade thermometric scale are used throughout. There are also added excellent tables of French Measures; Elementary Atoms; Specific Gravities of Gases and Vapours; and Logarithms and Anti-Logarithms, with a very correct and copious index.

As far as our recollection goes we do not think that there exists in any language a book on so difficult a subject as this, so carefully, clearly, and lucidly written. The author, moreover, deserves the thanks of all English students of chemistry and friends of science, for having entrusted the publication of his work to so well-known an English firm, and the publishers are equally praiseworthy for the excellent execution of a book, requiring, as it does for its completion, extreme care, as well as specially cut types for some of the formulæ. We recommend this work to all who desire to become thoroughly conversant with a somewhat intricate but very important subject.

*Lecture Notes for Chemical Students.* By EDWARD FRANKLAND, F.R.S., &c., Professor of Chemistry in the Royal School of Mines. Vol. I.—Inorganic Chemistry. Second Edition. Pp. 220. London: John Van Voorst. 1870.

THIS is the first part of a second and revised edition of Dr. Frankland's work. It is not a manual of chemistry in the ordinary sense of the word; for it says but little of the manufacture of chemical compounds: it scarcely alludes to their outward and sensible properties; but it gives many glimpses of their interior constitution. These Notes were originally published in one volume; but, at the request of numerous readers, the eminent author has divided the work into two parts, of which this volume forms the first. The author's aim has been to classify, and systematise rather than to describe, and to furnish the student with a kind of skeleton of the science; it being the author's intention that the student should himself clothe and dress this skeleton with the already-known and daily-increasing facts of experimental research. To aid the student in that good and useful work, the titles of the works published by several eminent English, as well as foreign, authors of works on chemistry are quoted. The graphic notation of Dr. Crum Brown, which was adopted, in the former edition, to illustrate important constitutional formulæ, has been somewhat modified in the present, by the omission of the circles surrounding the symbols of the elements; the author's previous opinion, that these circles render the formulæ more intelligible to beginners, not having been confirmed in practice. Since, however, during the time which has elapsed since the publication of the first edition of this work, this modified form of graphic notation has been adopted by a large number of chemists, it is desirable that the student should use that form which is most extensively employed, and which, as regards constitutional formulæ, has become almost a necessity to give precision to that hypothetical reasoning which stimulates to further research.

Since this work was first published, many of its peculiar novelties have become, as might be expected, generally known and appreciated, if not as yet generally adopted

\* Acetate of potash probably not all washed out by alcohol.

† Unaccountably high.

‡ *Anal. Ch. Sechste Auflage, Zweiter Band, p. 128.*



by chemists. The contents and general arrangement of this volume is not altered, but it has been increased by the addition of the constitutional formulæ of minerals. The opening chapters—Introductory, Chemical Nomenclature, Chemical Notation, Compound Radicals, Atomic and Molecular Combination—are so tersely worded that any student may readily and quickly catch the meaning intended to be conveyed to the mind. The whole book is an *epitome*, but of great utility, since the eminent author has succeeded in rendering modern chemistry, with all its at first sight great intricacies and difficulties, readily understood, whilst the disciple gradually ascends from the more simple to the more complex matters, and is almost imperceptibly brought into the domain of organic chemistry.

*Eminent Men of the Day.* Photographed by G. C. WALLICH, M.D. Scientific Series. London: John Van Voorst, Paternoster Row. 1870.

BIOGRAPHIES and autobiographies of those we have known, and who are honoured by us for their worth, their discoveries, and scientific attainments, are valuable, and we could ill afford to dispense with these memorials. But, after all, there is nothing more pleasant than to possess a faithful representation of the features and expression of those holding a foremost place in the ranks of science; and, in looking over these photographs, it is easy to recall the various discoveries which have led to well-deserved honours and world-wide fame.

The volume contains most characteristic likenesses of:—General Sir Edward Sabine, K.C.B.; Sir Roderick Impey Murchison, Bart., K.C.B., F.R.S.; Professor Owen, D.C.L., F.R.S.; George Bentham, F.R.S.; Thomas H. Huxley, LL.D., F.R.S.; Joseph Dalton Hooker, C.B., D.C.L., LL.D., F.R.S.; Sir Charles Lyell, Bart., F.R.S.; John Tyndall, LL.D., F.R.S.; Sir William Logan, F.R.S.; Professor Stokes, M.A., D.C.L., LL.D., F.R.S.; Professor A. C. Ramsay, LL.D., F.R.S., F.G.S.; Viscount Walden; William Lassell, F.R.S.; Joseph Prestwich, F.R.S.; Rev. J. B. Reade, M.A., F.R.S.; and Professor Williamson, F.R.S.

We wish that the series could be greatly extended, so as to include many more in each department of science. We should like to see, in addition to this volume (which contains, for the most part, the presidents of the various scientific societies), a volume containing portraits of the most distinguished chemists; another, of those who have devoted years of labour to physical researches; another, of eminent geologists, &c. And we hope that this volume will have such an extensive circulation, and be so well received, that Dr. Wallich will decide upon issuing at least one more volume of scientific celebrities.

The photographs are well executed, and handsomely mounted and bound; and the book cannot fail to be highly prized.

*The Fuel of the Sun.* By W. MATTIEU WILLIAMS, F.C.S., &c. Pp. 222. London: Simpkin, Marshall, and Co. 1870.

UNDER this title, which, to ordinary minds, might appear absurd enough to suggest doubts as to the writer's sanity, the author has made an attempt (and a very bold one) to explain some of the greatest mysteries of the Universe.

Mr. Williams certainly deserves extraordinary credit for this work; for, although it is quite true, as he himself says, that he fairly exposes himself to the accusation of extreme presumption, the whole work bears testimony of sound and deep study of physical sciences, and of an acute mind and great sagacity for observing and applying facts. And, although the work abounds in speculations as yet not proved (and it may be doubted whether man ever will be able, while on this globe, to learn and to prove the real truth), they are here lucidly set forth in print, and are therefore suggestive of good, inasmuch as their perusal may assist others to elicit new facts.

The following quotation will give, perhaps, the key-note of the book:—

"The sun, according to my hypothesis, is a hollow flame, with dissociated combustible gases within it, and a nucleus of some kind within them. It differs from the hollow flame of a candle in the very important respect of not being dependent upon external oxygen for its support. It contains all the materials of combustion within itself; but this combustion, or combination, is restrained from proceeding explosively inwards by the dissociating force of the high temperature of the inner gases.

"When two substances, such as oxygen and hydrogen, combine chemically, they evolve an amount of heat exactly equivalent to that which is required to drive asunder the constituents of an equal quantity of the compound which they form; and, therefore, the amount of combination or combustion that can take place in a given mixture of such elementary gases is limited by the quantity of heat which surrounding bodies are capable of abstracting. To illustrate this, let us conceive the case of a certain quantity of the elements of water heated exactly to the temperature of dissociation, and confined in a vessel the sides of which are maintained externally at precisely the same temperature as the gases within, so that no heat can be added or taken away from the gases. No sensible amount of combination could now take place, as the first infinitesimal effort of combustion would set free just the amount of heat required to decompose its own result. In like manner, if a quantity of aqueous vapour were subjected to the same conditions, there would be a corresponding equilibrium; and no sensible amount of dissociation could take place, as the first effort of dissociation would be attended with a conversion of heat, and consequent loss of temperature, which would be exactly compensated by the instantaneous reunion or combustion of the infinitesimally small quantity of dissociated water.

"Let us now suppose a modification of these conditions; viz., that the vessel containing the dissociated gases at the temperature of dissociation shall be surrounded with bodies cooler than itself, *i.e.*, capable of receiving more heat from it than they radiate towards it. There would then take place just so much combustion as would set free the amount of heat required to maintain the temperature of the vessel at the dissociation-point; or, in other words, combustion would go on to the extent of setting free just as much heat as the gaseous mass was capable of radiating, or otherwise transmitting to surrounding bodies; and this amount of combustion would regularly and steadily continue until all the gases had combined.

"We have only to give this hypothetical vessel a spherical form and an internal diameter of 853,380 miles, to construct its enveloping sides of a thick shell of aqueous vapour, and then, by placing in the midst of the contained gases a central nucleus of solid or liquid matter, we are hypothetically supplied with the main conditions which I suppose to exist in the sun."

We purposely abstain from entering into further details; since, by thus dissecting, we might risk misrepresenting the contents of a work which abounds with valuable information on cosmography in its widest sense.

The work is very readable; and the typographical execution is also excellent.

## CORRESPONDENCE.

### ANALYSTS' FEES.

*To the Editor of the Chemical News.*

SIR,—Some time since, a few letters appeared in your paper on high and low analysts and their fees. Now, in the north of England, people will not pay the fees that more favoured localities obtain; but I was not prepared for a circular (which I beg to enclose) which informs the



world that a Ph.D. and F.C.S. will execute any complete analysis for £1 is., and anything less complete for 10s. 6d. He also states that he holds testimonials from the most renowned scientific men of the day; and winds up by advertising himself as a chemical broker.

How hard, indeed, is the lot of the analyst whose views of professional *status* will not permit of dabbling in shop-keeping!—I am, &c.,

OLD PRICE.

## STELLARTON ACID-WATER ANALYSIS.

*To the Editor of the Chemical News.*

SIR,—I have just received Nos. 548 and 549 of the CHEMICAL NEWS, and learn from them that my late paper "On the Stellarton Water," published by the Chemical Society, has been the subject of discussion. I am obliged to Dr. Gladstone for showing Mr. Spiller how my statement as to free sulphuric acid being present is quite admissible, and for explaining to him the meaning of the word *underlying* (the rocks and coal dip at an angle of 20°).

With regard to alumina being given in the deposits and not in the water, I may say that analysis was made on *filtered* water, and that insoluble aluminous matter may have been introduced into the boilers on the "fibres, apparently, of roots" mentioned as found in the incrustation. The amount present was quite trifling. I find it stated, however, in my note-book that there was a trace of alumina in both waters; and no doubt I ought to have mentioned this substance among the other ingredients (I suppose I thought it too small in amount).

As for silica mentioned in the water and not in the deposits, the amount dissolved in the water was only (at most) 0.52 of a grain to the gallon. And, being soluble, why should it necessarily have been in the deposit? and why, under the circumstances, was it material to look for it if in small amount?

Hoping that some useful discussion on essential points (especially as to arrangement of results of water analysis) may arise from Mr. Spiller's criticism of my paper, I am, &c.,

HENRY HOW.

University of King's College,  
Windsor, Nova Scotia, June 16th, 1870.

## MISCELLANEOUS.

The Cryophorus, &c., with Bunsen's Pump.\*—Professor Cooke finds that the Bunsen Pump will serve admirably for freezing the cryophorus by evaporation of ether. The lower bulb is wrapped about with several folds of cotton, which are drenched with ether, the tube being passed through an india-rubber cork fitting into the tubulure of a receiver, which is placed upon an air-pump plate connecting with the Bunsen pump. The cold produced by the rapid evaporation of the ether in vacuo, causes the water in the upper bulb to freeze rapidly. Bunsen's pump is applicable not only in this but in many other cases in which the condensation of moisture, or the presence of corrosive gases and liquids forbid the employment of the common air-pump. As for example, the familiar experiment of making tepid water boil violently when placed in a partially exhausted atmosphere. Indeed, Bunsen's pump may be made to take the place of the air-pump for almost all purposes, and forms a most valuable adjunct not only to the laboratory, but also to the lecture-table. In the filtration of large quantities of acids, alkalies, &c., a funnel may be employed of a half-gallon capacity or larger, and closed by means of sealing-wax with a conical plug of pumice of about  $\frac{3}{4}$  inch thickness. The bulb of the funnel is then passed through the

tubulure of a receiver as above. Besides this useful contrivance, Professor Cooke has found the Bunsen filter to work well where large masses of precipitate must be dealt with. In this case a zinc cone, three inches in depth, which is cut, formed up and soldered in the same way as the small platinum cone, described by Bunsen, is fitted into a large funnel. Several pounds of precipitate may be thrown upon a single thickness of filter paper, which is supported by a cone of this description, and washed rapidly and completely under atmospheric pressure. If it is not desired to preserve the filtrate and wash-water, the tube of the filter may be fitted directly into the exhaust pipe of the pump, and the liquid carried off along with the air. Such arrangements as those detailed above would greatly economise the time, labour, and working space of pharmacutists and manufacturing chemists.—*Journal of the Franklin Institute.*

## NOTES AND QUERIES.

Bromine.—(Reply to "J. H. Watson.")—Consult the latest edition of Rose's "Analytical Chemistry," recently published in the German language; or Fresenius's "Quantitative Analysis," latest English edition.

Persulphide of Hydrogen.—(Reply to "W. B. G.")—Consult "Handbook of Chemistry," by Gmelin; Watts's "Dictionary of Chemistry;" and "Jahresbericht über die Fortschritte der Chemie," von Kopp and Will; all of which works you may inspect at the Library of the Commissioners of Patents.

Lead Roofing.—The lead on the ridgings of my house dissolves with rain, and streaks of whitish-looking stuff runs irregularly over the slates from these various ridgings. As the slates are much exposed to view, it looks very ugly in dry weather. Can any one suggest a remedy?—SLATES.

Work on Sulphur.—Can any of your numerous correspondents kindly inform me of a book on sulphur, giving a lucid explanation of its extraction from clays, pyrites, &c.; the quantity of fuel used, the percentage of sulphur which would be payable to work, and the description and average cost of plant necessary for its production as a marketable article? I have looked in Watts's "Dictionary," Muspratt, and several other works, but the information is scarcely so full as I require.—GEORGE CRAMPTON.

Latest Novelty in Orchil Paste.—The great advance in the price of orchella weeds has put the manufacturers of weed colours upon their mettle. Many sophistications have become known to consumers. So the last "improvement" is to buy up spent weed from parties who make orchil liquor for their own consumption, and incorporate it with the recent weed in the process of manufacture. Thus a very solid paste is obtained, in which the microscope reveals nothing objectionable. The only method of detecting this ingenious dodge is to compare the tinctorial power of the sample against that of a genuine sample equally low in moisture.—W.

## TO CORRESPONDENTS.

Richard Weaver.—There is no material improvement in the second edition.

J. L. Sinclair (Auckland).—The specimens of auriferous quartz, together with your letter, have been received, for which please accept our thanks.

W. H. Walenn is thanked for his kind communication.

J. Phin.—We have pleasure in acceding to your request. Your book has been received.

D. T. Hughes.—Received with thanks.

The Secretary of the Royal Society is thanked for his communication.

F. H. T. A.—We should recommend Watts's "Dictionary of Chemistry," (Longmans), £7 3s., Miller's "Elements of Chemistry," 6os., (Longmans), Fownes's "Manual of Chemistry," (Churchill), 14s., Odling's "Outlines of Chemistry," (Longmans), 7s. 6d., Bowman's "Practical Chemistry," (Churchill), 6s. 6d., Bowman's "Medical Chemistry," (Churchill), 6s. 6d., Roscoe's "Elementary Chemistry," (Macmillan), Bloxam's "Laboratory Teaching," (Churchill), 5s. 6d.

J. B. Lippincott and Co.—Received.

W. H. Wood.—Your communication shall receive early attention. It arrived too late for this week.

J. Wilson.—You had better write to the Editor of the *Annales du Génie Civil*. We do not know the address of Dr. Reinsch. Dr. Otto's memoir was in the *Journal of the Franklin Institute*, for January, 1870, which is published in Philadelphia, U.S.A.

## BOOKS RECEIVED.

The Chemical History of the Six Days of Creation. By John Phin, C.E. New York: American News Company.  
The Retrospect of Medicine. Edited by W. Braithwaite, M.D., and J. Braithwaite, M.D. Lond. Vol. lxi. January—June, 1870. London: Simpkin, Marshall and Co.

\* Communicated by Professor Norton.



# THE CHEMICAL NEWS.

VOL. XXII. No. 554.

## PRELIMINARY NOTE ON THE PREVENTION OF MOULDINESS IN AQUEOUS SOLUTIONS OF TARTARIC ACID.

By WILLIAM H. WOOD,  
Middlesbro'-on-Tees.

IN July, 1867, I commenced experiments (which I have continued at various times since, and of which all are still in progress) to determine whether it was possible to prevent the formation of mould which usually occurs in aqueous solutions of tartaric acid a short time after their preparation.

I first tried the addition of creosote, of which I found a single drop effectual in preserving an ounce of solution of 1 part of acid in 2 parts of water.\* A week or two since, a friend of mine called my attention to a very similar method of preservation, or prevention, in Bowman's "Practical Chemistry" (5th edition, p. 241), where it is stated, in a foot-note, that the mouldiness "may be prevented by adding a very minute quantity of carbolic acid, which does not interfere with the uses of tartaric acid in analysis."

I do not write to claim priority in the discovery of the above-stated fact, but to make known that, so far, my experiments lead or point to the conclusion that, if a solution of tartaric acid in water, whether mouldy or not, be filtered, and then boiled for a short time (say ten minutes), it will not afterwards become mouldy, whether corked or stoppered up in a bottle, or left exposed to the air.

The details of the various experiments I reserve for a future and longer paper, when I have ascertained the results of several experiments made for confirmation. The statement just made will, in my opinion, if confirmed, be important as bearing on the so-called "spontaneous generation" controversy, and will, I think, throw some light on it. A similar mode of experiment I intend to apply to citric acid and various other substances whose solutions are similarly decomposed. I shall also endeavour to ascertain the cause of the non-formation of the mould.

The delay in the publication of the above experimental result arises from the length of time which an experiment of this kind must be in operation before reliable results can be obtained.

June 28th, 1870.

## ON THE FORMATION OF OZONE BY RAPID COMBUSTION.

By O. LOEW,  
Assistant in the Chemical Department of the College of the  
City of New York.†

ACCORDING to the view of Schönbein, every slow oxidation is accompanied by formation of ozone, common oxygen not being able to combine directly with the elements. In 1858, Clausius advanced the hypothesis that ozone is oxygen in the state of *free atoms*, while common oxygen consists of a *molecule of two combined atoms*. But the later investigations of Andrews and Tait, Babo, and Soret, upon the volume of ozone have not supported this

notion; and Clausius has modified his hypothesis accordingly, now believing that ozone is a combination between *an atom and a molecule of oxygen*. This combination is but a loose one; and the power of oxidation resides in the third atom of oxygen, which combines directly with other substances, leaving common oxygen behind. This constitution of ozone may be represented by the following formula:— $3([OO]) = 2([OO]O)$ .

The oxidation of a metal by ozone is shown by the equation,  $([OO]O) + M = MO + ([OO])$ .

When we now take into consideration that ozone and antozone together give common oxygen, we must conclude that antozone is oxygen in the state of free atoms. Furthermore, we see that common oxygen can be converted, according to circumstances, either into ozone or antozone. It seemed to me that, in every combustion, even the most rapid and energetic, an intermediate decomposition of the molecule of common oxygen must take place if the single atoms will enter into combination with the elements, and that ozone or antozone would be detected in a flame if the high temperature would not destroy it again as quickly as it is formed.

To prove this conclusion, I blew a strong current of air through a tube, into a flame of a Bunsen's burner and collected the air in a beaker glass or balloon. I was thus able, in a few seconds, to collect enough ozone to readily identify it by its intense odour, and by the common tests.

This observation shows that, not only in slow oxidation, but also in rapid combustion, an intermediate formation of ozone takes place,\* and that it can be separated in the proper way.—*American Journal of Science*, vol. xlix., p. 369.

## REMARKS ON THE ALKALIES CONTAINED IN THE MINERAL LEUCITE.

By J. LAWRENCE SMITH.

IN examining recently many of the silicates containing alkalies, my attention has been called to leucite, and it is on that mineral especially that I would now remark, reserving for another time my observations on the other silicates.

The specimens of leucite examined came from four localities—Vesuvius, Andernach, Borghetta, and Frescati. They were about as good specimens as are obtained from those localities, although all of them were not equally pure. The alkalies found in each calculated as potash were—

Vesuvius	..	..	..	..	..	21.85
Andernach	..	..	..	..	..	20.06
Borghetta	..	..	..	..	..	20.68
Frescati..	..	..	..	..	..	20.38

The specimen from Andernach was analysed for the silica, &c., and found to contain—Silica 54.75, alumina 23.08, and 1.55 of oxide of iron; this last seemed to be mechanically disseminated through the crystals.

I say above in relation to the alkalies "all calculated as potash," for the reason that there is a notable quantity of rubidium and caesium present in all the specimens above mentioned. In fact, by the method adopted in testing for these alkalies abundant indications are obtained of the presence of rubidium and caesium (the last not so readily), even when operating on but  $\frac{1}{2}$  a gm. of the mineral. I am now engaged in working out a method of estimating quantitatively rubidium and caesium in the presence of other alkalies; by this method, not yet perfected, the quantity of these alkalies in leucite is found to be about 9-10ths of 1 per cent of the entire mineral.

Of course it is not at all remarkable that the potash in the different specimens of leucite should be the same; but it is a matter of interest to know that, from whatso-

\* Strength recommended in Galloway's "Qualitative Analysis," for analytical purposes.

† Read before the Lyceum of Natural Science, New York.

\* Compare the observation of Pincus in the article "On Nitrification," *American Journal of Science*, II., vol. ii., p. 238.



ever locality it comes, this minute quantity of rubidium and caesium occurs with it. On some future occasion I hope to be able to bring together certain generalities in this connection of more or less interest to mineralogists.

I have also detected rubidium in  $\frac{1}{2}$  grm. of margarodite and Warwick mica, and have failed to detect it in apophyllite, Thomsonite, pectolite, elæolite, chesterlite, cancrinite, and other silicates.—*American Journal of Science*, vol. xlix., p. 335.

## ON THE

## COMPOSITION OF THE ACID-OXALATES OF POTASSIUM, AMMONIUM, AND SODIUM.\*

By WILLIAM RIPLEY NICHOLS,  
of Boston, Massachusetts.

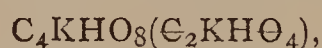
*Binoxalate of Potassium.*

THE composition of this salt was formerly held to be expressed by the formula†  $\text{KO}, \text{C}_4\text{O}_6 + 3\text{HO}(\text{C}_2\text{KH}\Theta_4 + \text{aq.})$ ; and this formula is still given by Gmelin, Watts, and others, as that of the commonly-occurring salt.

Rammelsberg,‡ on the other hand, describes the salt obtained by neutralising a certain quantity of oxalic acid with carbonate of potassium, and adding an equal amount of oxalic acid, as corresponding to the formula—



Marignac,|| having afterwards partially analysed this salt, concluded that the correct formula was—



and that the crystals contained no water of crystallisation. He differed from Rammelsberg as to the system to which the crystals should be referred; and the latter afterwards§ acknowledges the correctness of Marignac's views as to the crystalline form, and, without repeating the analysis of the salt, seems satisfied to accept the formula assigned by Marignac.

I have prepared this salt in the manner indicated by Rammelsberg, and find that its composition agrees with the formula originally given by him.

Calculated.		Found.								Mean.
		I.	II.	III.	IV.	V.	VI.	VII.	VIII.	
$2\text{K}_2\text{O}$	188.44 35.53	—	—	—	35.55	35.05	—	—	—	35.30
$4\text{C}_2\text{O}_3$	288.00 54.29	55.35	55.67	55.76	—	—	—	—	—	55.76
$3\text{aq.}$	54.00 10.18	—	—	—	—	—	10.16	10.39	10.58	10.34
— 530.44 100.00										
$4(\text{C}_2\text{KHO}_4) + \text{aq.}$										

In these analyses, I determined the potassium as carbonate, by igniting a portion of the finely-powdered crystals in a covered platinum crucible, raising the heat very gradually in order to avoid loss by projection, to which, as Marignac hints, this salt is particularly liable. The oxalic acid was determined by titration with a solution of permanganate of potassium, standardised against pure oxalic acid. The hydrogen was determined by igniting the salt, in a combustion-tube, in a stream of dry air, and collecting the water in a weighed chloride of calcium tube.

## RAMMELSBERG'S

Formula demands.		Own figures were.			
$2\text{KO}$	.. 35.53	.. ..	36.41	.. 35.22	.. 35.36
$2\text{C}_4\text{O}_6$	.. 54.29	.. ..	55.31	.. 54.32	.. 54.00
$3\text{aq.}$	.. 10.18	.. ..	—	.. —	.. —
— 100.00					

\* From the *Proceedings of the American Association for the Advancement of Science*, 1869.

† On the authority of Graham (*Phil. Trans.*, 1837, p. 50).

‡ *Pogg. Ann.*, vol. xciii., 24 (1854).

§ *Mém. de la Soc. d. Phys. et d'Hist. Nat. de Genève*, t. xiv., Part I. (1855).

§ "Supplement zu dem Handbuch der Krystallographischen Chemie." Leipzig, 1857, s. 87.

## MARIGNAC'S

		Formula demands.		Own figures were.	
KO	.. ..	36.78	.. ..	36.35*	
$\text{C}_4\text{O}_6$	.. ..	56.19	.. ..	55.86	
HO	.. ..	7.03	.. ..	—	
		—		—	
		100.00			

Had Marignac determined the hydrogen in his salt, he would have found his formula to be inadmissible.

In regard to the acid-oxalate described by Graham (*loc. cit.*),† it is extremely doubtful whether there be such a salt. Rammelsberg‡ doubts its existence; and I have myself been unable to procure it. I added to a hot solution of a known quantity of oxalic acid half the carbonate of potassium necessary to neutralise it. The crystals which formed in the hot solution (A), those deposited from the solution at the ordinary temperature (B), as well as those deposited when the solution was artificially cooled to a considerably lower temperature (C), proved to be the quadroxalate,  $\text{C}_2\text{KH}\Theta_4, \text{C}_2\text{H}_2\Theta_4 + 2\text{aq.}$

	Calculated.		Found.				
			A.			B.	
			I.	II.	III.	I.	II.
$\text{K}_2\text{O}$	94.22	18.54	—	—	18.41	18.53	—
$4\text{C}_2\text{O}_3$	288.00	56.67	56.23	56.52	—	—	56.86
$3\text{H}_2\text{O}$	54.00	24.79	—	—	—	—	—
$4\text{aq.} \dots$	72.00						
————— 508.22 100.00							
$2(\text{C}_2\text{KH}\Theta_4, \text{C}_2\text{H}_2\Theta_4, + 2\text{aq.})$							

In these estimations, the potassium was determined as carbonate, by ignition; and the oxalic acid by titration, as in the preceding case.

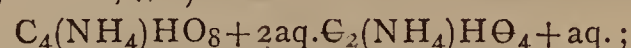
I analysed several samples of commercial "binoxalate of potash," but each sample proved to be quadroxalate.

*Binoxalate of Ammonium.*

This salt was prepared by neutralising a certain quantity of oxalic acid with ammonia-water, and then adding an equal quantity of oxalic acid. Analysis showed the composition of the salt to be  $2(\text{C}_2(\text{NH}_4)\text{H}\Theta_4) + \text{aq.}$

	Calculated.		Found.				Mean.
			I.	II.	III.	IV.	
$(\text{NH}_4)_2\text{O}$	.. 52	22.41	—	—	21.54	—	21.54
$2\text{C}_2\text{O}_3$	.. 144	62.08	61.35	61.57	—	—	61.46
$\text{H}_2\text{O}$	.. 18	7.75	—	—	—	—	—
$\text{aq.}$	.. 18	7.76	—	—	—	7.50	7.50
— 232 100.00							
$2(\text{C}_2(\text{NH}_4)\text{H}\Theta_4) + \text{aq.}$							

The formula usually given in text-books on chemistry (Gmelin, Watts, &c.) is—



that is, with one more molecule of water than I find to be the case. For this formula the calculated percentages would be—

$(\text{NH}_4)_2\text{O}$	.. ..	52	.. ..	20.80
$2\text{C}_2\text{O}_3$	.. ..	144	.. ..	57.60
$\text{H}_2\text{O}$	.. ..	18	.. ..	7.20
$2\text{aq.}$	.. ..	36	.. ..	14.40
— 100.00		250		

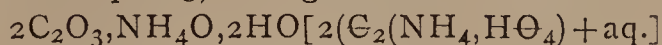
\* Mean of four.

		Calculated.		Found.		
† KO	.. ..	32.24	.. ..	32.34	.. ..	} Graham deduced this formula from the amount of carbonate of potassium left on ignition (47.45 per cent).
C <sub>4</sub> O <sub>6</sub>	.. ..	49.28	.. ..	—	.. ..	
3HO	.. ..	18.48	.. ..	—	.. ..	
		<u>100.00</u>				

† *Pogg. Ann.*, vol. xciii., p. 24 (*supra cit.*)



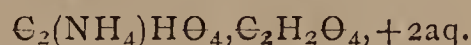
Anderson\* says that the binoxalate of ammonium may be obtained by mixing equivalent quantities of chloride of ammonium and oxalic acid (regarded as monobasic,  $C_2O_3.HO + 2aq. = 63$ ), and gives as the formula—



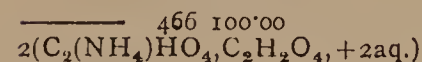
He determined the oxalic acid alone; and, from the data that he gives, it would appear that, instead of the binoxalate, he really obtained the quadroxalate mentioned below.

Percentage of $C_2O_3$		
In his salt.	In the acid-salt above.	In the hyper-acid salt below.
61.92	62.08	61.80

I found that, by adding a hot solution of 53.5 grms. (1 equiv.) chloride of ammonium ( $NH_4Cl$ ) to a hot solution of 63 grms. ( $\frac{1}{2}$  equiv.) of crystallised oxalic acid ( $C_2H_2O_4 + 2aq.$ ), there were deposited, on cooling, crystals of the hyperacid salt of the formula—



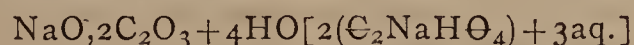
	Calculated.		Found.						Mean.
	I.	II.	III.	IV.	V.	VI.			
$(NH_4)_2O$	52	11.16	11.12	11.29	—	—	—	11.29	
$4C_2O_3$	288	61.80	—	—	61.14	61.14	61.09	—	61.12
$3H_2O$	54	11.59	—	—	—	—	—	—	—
$4aq.$	72	15.45	—	—	—	—	15.81	15.81	



In these analyses, the ammonium was determined as chloroplatinate of ammonium, the oxalic acid by titration, and the water of crystallisation by drying at  $100^\circ C.$  until the weight remained constant.

#### Binoxalate of Sodium.

Anderson (*loc. cit.*) says that, by dissolving equivalent proportions of oxalic acid (equiv. = 63) and chloride of sodium (equiv. = 58.5) in hot water, crystals of this salt are obtained on cooling the solution. He gives the formula for the same:—



I found that crystals of the binoxalate were deposited from such a mixture, but that they answered to the commonly-received formula—



	Calculated.		Found.		Mean.
	I.	II.	I.	II.	
$Na_2O$	62	23.85	—	—	—
$2C_2O_3$	144	55.38	55.19	55.24	55.22
$H_2O$	54	20.77	—	—	—
$2aq.$	—	—	—	—	—
	260	100.00			



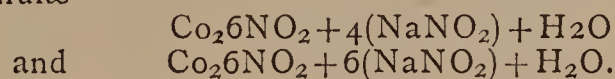
### ON THE POTASSIO-COBALTIC NITRITE KNOWN AS FISCHER'S SALT, AND SOME ANALOGOUS AND RELATED COMPOUNDS.

By SAMUEL P. SADTLER.

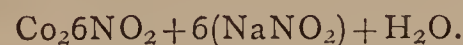
(Continued from p. 10.)

HAVING formed, from these analytical results, our conclusions, let us see if we can find any confirmation of them from other sources. Lang† states that, although the corresponding soda and ammonia salts were probably formed, yet they could not be obtained on account of

their solubility. By using a strong  $NaNO_2$  solution,\* I succeeded in obtaining the new soda compounds which I am about to describe. To a solution of  $CoCl_2$ , which had been boiled and then acidified with acetic acid, I added an excess of  $NaNO_2$  solution. The mixture instantly became of a dark colour, and a yellowish-brown salt began to form, with brisk evolution of nitric oxide. After some hours, when the evolution of gas was progressing but slowly, I added some more of the  $NaNO_2$  solution, testing, also, to assure myself that the solution was acid; and, in a little while, the solution began to assume a yellowish colour, and I found a clear, yellow salt depositing. This led to the conjecture that there were two distinct soda-salts. I accordingly sought to obtain them distinct, for analysis. This I found to be difficult. The brown salt I readily got almost pure, but succeeded only partially in obtaining the yellow one distinct. The brown salt continues to form, to a greater or less extent, even after the formation of the yellow one has begun. The preparations were all washed with acetate of soda, which was displaced with alcohol. From analyses of them, and from other and subsequent results, I am led to consider them as salts analogous to Fischer's salt, and differing from each other in the number of atoms of  $NaNO_2$  in combination with the  $Co_26NO_2$ . The brown salt I would call a *di-sodio-cobaltic-nitrite*, and the yellow one a *tri-sodio-cobaltic-nitrite*; giving them respectively the formulæ—



		Theor. p. cts.		Found p. cts.	
$Co_2O_3$	.. ..	24.13	23.71	23.21	
$Na_2O$	.. ..	18.02	18.37	18.70	
$N_2O_3$	.. ..	55.23	—	47.07 (?)†	
$H_2O$	.. ..	2.62	—	6.66 (?)†	



		Theor. p. cts.		Found p. cts.	
$Co_2O_3$	.. ..	20.10	20.53	22.04	22.18
$Na_2O$	.. ..	22.52	20.70	20.31	19.21
$N_2O_3$	.. ..	55.20	—	—	[20.54]
$H_2O$	.. ..	2.18	—	—	—

Some error connected with the  $CaCl_2$  tube, which I am entirely unable to account for, has here caused an error. It will be observed that in each case the total loss of the combustion-tube is very nearly what the theoretical per cent of  $H_2O + N$  would demand, while the increase in the  $CaCl_2$  tube is out of all proportion. If we examine the results in the yellow salt, we see that all these preparations are more or less mixtures. The last preparation, indeed, might be put equally under the head of the 2-atom salt, the per cent in brackets showing the per cent  $Na_2O$  calculated on the other formula. We are fortunately, however, not dependent solely on these analyses for our evidences of the existence of these two salts. On account of their partial solubility, we are enabled to obtain substitution-compounds from them, which throw very strong light on the composition of the alkali-cobaltic nitrites.

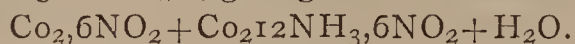
\* The  $KNO_3$  and  $NaNO_2$  solutions used in this work were prepared as follows:—1 part of nitre and 2 parts of lead were fused together, after Stromeyer's well-known method. After the complete oxidation of the lead, the residue was boiled several times with water. The solution was then filtered, to remove the undissolved litharge. Into the filtrate (which contained more or less free alkali) the red gas evolved from nitric acid and sawdust was passed, until a neutral reaction was obtained. This red gas, however, does not consist of the oxides of nitrogen alone; it also contains some carbonic acid. This throws down, as carbonate of lead, the litharge which had gone into solution. It is now filtered, and the filtrate evaporated to an oily consistency, when the saltpetre in it will almost all crystallise out. We filter it again, and, if we wish it still purer, we can give it the treatment with alcohol described by Hampe (*Ann. Ch. u. Ph.*, 125, 335); this frees it completely from saltpetre, and concentrates it.

† The found percentages of  $N + H_2O$  in the brown salt is the average of two determinations.

\* *Qu. Journ. Chem. Soc.*, vol. i., 231 (1849).  
† *Jr. Pr. Ch.*, lxxxvii., 303.



In one case, after the formation and filtering-off of some of the brown salt, chloride of luteo-cobalt was added to the wine-coloured filtrate, which probably held some of both salts in solution. The strong tendency which luteo-cobalt possesses to form double salts suggested to Dr. Gibbs that some results might be here obtained. A beautiful, yellow, crystalline salt formed and settled quite readily. I then prepared a considerable amount of it, for analysis. It proved to be as good as insoluble in cold water; so that its washing was an easy matter. Its analysis shows very clearly that it was formed from the tri-sodio-cobaltic nitrite, or yellow soda-salt, which existed in the solution, and that 1 atom of luteo-cobalt exactly replaces the 3 of  $\text{Na}_2\text{O}$ , giving it the formula—



	Theor. p. cts.	Found p. cts.
$\text{Co}_2\text{O}_3$ .. ..	32.87	33.04
$\text{NH}_3$ .. ..	20.20	19.91
$\text{N}_2\text{O}_3$ .. ..	45.15	44.50
$\text{H}_2\text{O}$ .. ..	1.78	2.37

I now tried chloride of purpureo-cobalt upon some of the same solution, and got a roseo-cobalt compound exactly analogous to that of luteo-cobalt, its formula being  $\text{Co}_2, 6\text{NO}_2 + \text{Co}_2, 10\text{NH}_3, 6\text{NO}_2 + \text{H}_2\text{O}$ .

The following were the analytical results:—

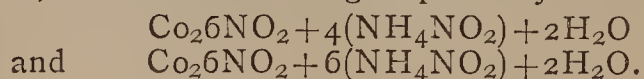


	Theor. p. cts.	Found p. cts.
$\text{Co}_2\text{O}_3$ .. ..	34.02	33.18

This salt is not nearly as insoluble, however, as the luteo-cobalt salt, and but little of it could be obtained. At first I got it as a yellow and very crystalline salt on the sides of the beaker, after standing some little time. The crystals, examined under the microscope, were beautifully-defined, monoclinic prisms, with terminal planes. The portion I analysed had more of the colour of the salts of roseo-cobalt, and showed, under the microscope, a star-shaped aggregation of small crystals.

I also formed, in the soda-salt solution, a yellowish xantho-cobalt compound, having probably an analogous constitution, but did not get enough of it to analyse. Examined under the microscope, the crystals were seen to be of a peculiar cup-shaped appearance, and quite large and pointed.

The ammonium-salts were next examined. That one, at least, existed had been found by Gibbs and Genth,\* although it had not been analysed by them. Erdmann† had, however, formed an ammonium-salt exactly corresponding to Fischer's salt. I succeeded in forming this and another; the two exactly corresponding, in constitution, to the two soda-salts. The circumstances under which the different salts form I am not able, however, to state at all positively, except that, in forming the 3-atom salt, I had more concentrated  $\text{CoCl}_2$  and  $\text{NH}_4\text{NO}_2$  solution. They are both bright yellow, and could not be distinguished by their colour. We may term them the *di-ammonio-cobaltic nitrite* and the *tri-ammonio-cobaltic nitrite*, their formulæ being respectively—



	Theor. p. cts.	Found p. cts.
$\text{Co}_2\text{O}_3$ .. ..	24.20	24.09

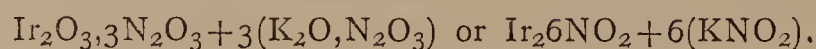


	Theor. p. ct.	Found p. ct.
$\text{Co}_2\text{O}_3$ .. ..	20.39	20.55

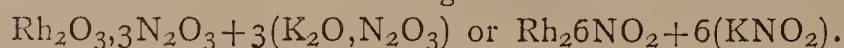
Lang is more nearly right in the case of these ammonia-compounds than in regard to the soda-salts, they being much more soluble. I was unable, however, to obtain

any substitution-compounds. With this additional light, we are now prepared to draw some conclusions. We find that our luteo-cobalt and roseo-cobalt compounds are exactly analogous to the cobaltcyanides of luteo-cobalt and roseo-cobalt formed by Gibbs and Genth,\* the only difference being that the monatomic radical  $\text{NO}_2$  here replaces the monatomic radical  $\text{Cy}$ . This, I think, gives us a very strong argument in favour of the exact analogy of the 3-atom soda-salt (and, with it, of Fischer's salt) to the cobaltcyanide of potassium, from which the salts of Gibbs and Genth were formed. With this view of these salts, we are able to discern yet other analogies. Iridium forms a number of sesquioxide-salts, very similar to those of cobalt. We have, indeed, two double chlorides of iridium, exactly analogous to the 2-atom and 3-atom soda or ammonia salts. Their formulæ are— $\text{Ir}_2\text{Cl}_6 + 4\text{KCl}$  and  $\text{Ir}_2\text{Cl}_6 + 6\text{KCl}$ , in which we should expect monatomic  $\text{Cl}$  to be exactly replaceable by monatomic  $\text{NO}$ ; and so we find that it is. Dr. Gibbs has discovered an iridium-salt, having the formula,  $\text{Ir}_2, 6\text{NO}_2 + 6(\text{KNO}_2) + 2\text{H}_2\text{O}$ , an exact analogue of Fischer's salt. Lang† also has discovered a rhodium-salt, whose formula,  $\text{Rh}_2, 6\text{NO}_2 + 6(\text{KNO}_2)$ , is precisely analogous. If we place together, for a moment, the three salts in question, their identity of constitution becomes apparent.

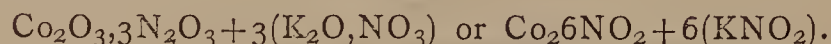
Gibbs.



Lang.

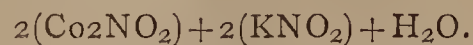


Sadtler.



If, therefore, we are to place any dependence at all upon analogy, the universal occurrence of the hexatomic  $\text{Co}_2$  atom in all our compounds is what we should expect *a priori*. The analyses of the series of salts, I think, fully confirms this expectation.

I have now to discuss some related compounds—those formed in neutral solutions. Erdmann first pointed out the distinction between these and the normal Fischer's salt. He obtained and analysed a yellow "neutral salt." I obtained one corresponding to this, and one of a different ratio. By adding a somewhat dilute solution of  $\text{KNO}_2$  to a warm solution of  $\text{CoCl}_2$ , I obtained a highly crystalline precipitate, which was shortly followed by a somewhat crystalline, greenish salt, which was again followed, after some time, by a yellowish precipitate with little or no crystalline character. The appearances were indicative of the successive formation of three protoxide-compounds. This, however, I found, was not the case. The black precipitate, under the microscope, was seen to consist of beautifully-defined cubes of a very dark green colour; and the green precipitate was seen to consist of similar cubes, though much smaller. Analysis afterward proved them to be the same salt in different states of aggregation. On adding a warm concentrated solution of  $\text{KNO}_2$ , however, to a warm concentrated solution of  $\text{CoCl}_2$ , nothing is formed but a flocculent yellow precipitate, which appears to be the same as that which I formed over mercury in the eudiometer-tube. The formulæ of these salts appear to be as follows:—For the black or green salt,  $2(\text{Co}_2\text{NO}_2) + 2(\text{KNO}_2) + \text{H}_2\text{O}$ ; and, for the yellow salt,  $\text{Co}_2\text{NO}_2 + 2(\text{KNO}_2) + \text{H}_2\text{O}$ . And the first may be termed a *potassio-dicobaltous nitrite*, and the second a *potassio-monocobaltous nitrite*.

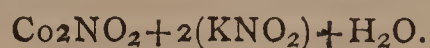


	Theor. p. cts.	Found p. cts.		
$\text{CoO}$ ..	30.60	30.65	29.67	30.79
$\text{K}_2\text{O}$ ..	19.22	19.85	21.78	19.87
$\text{N}_4\text{O}$ ..	46.51	—	—	—
$\text{H}_2\text{O}$ ..	3.67	—	—	—

\* "Researches on Ammonia-Cobalt Bases," p. 48.  
† *Jour. Pr. Ch.*, xcvi., 405.

\* "Researches on Ammonia-Cobalt Bases," pp. 40 and 18.  
† *Royal Swedish Acad. Trans.*, 1864.





	Theor. p. cts.	Found p. cts.
CoO .. ..	22.11	22.08
K <sub>2</sub> O .. ..	27.77	27.09
N <sub>4</sub> O .. ..	44.80	—
H <sub>2</sub> O .. ..	5.31	—

In looking over the analytical data of these analyses of protoxide-salts, we notice a striking similarity between the weights of salt taken and weights of double sulphates obtained. The explanation is very simple, and yet I believe there is involved in it a fact of importance. The similarity of weights is due to the similarity of atomic weights of N<sub>2</sub>O<sub>3</sub> and SO<sub>3</sub> (76 and 80) with which the bases are combined. Now, in none of the very many determinations made in the "acid-salts" do we find such a similarity; on the contrary, we find the weight of double sulphates to be invariably less than the weight of salt taken, and in a fixed ratio. The explanation of this is that Co<sub>2</sub>O<sub>3</sub>N<sub>2</sub>O<sub>3</sub>, by digestion with H<sub>2</sub>SO<sub>4</sub>, is converted into 2 atoms of neutral CoSO<sub>4</sub>, and becomes 2(CoSO<sub>4</sub>). 2CoO, 2N<sub>2</sub>O<sub>3</sub> simply assumes SO<sub>3</sub>, instead of N<sub>2</sub>O<sub>3</sub>, and becomes likewise 2(CoSO<sub>4</sub>). The first loses an atom of NO<sub>2</sub>, which the second does not. We have here a strong evidence of the totally different *habitus* of the Co atom in the "neutral" and in the "acid" salts.

(To be continued).

## ON THE ANILINE OR COAL-TAR COLOURS.\*

By W. H. PERKIN, F.R.S.

### Coal-Tar, Benzol, Nitrobenzol, Aniline, and Aniline Purple or Mauve.

IN this short course of lectures it is my desire to bring before you a somewhat condensed history of the artificial colouring matters, generally known as the "Coal-Tar Colours." By this designation it is not meant to imply that colouring matters actually exist in coal-tar, and may, therefore, be extracted from it, but that coal-tar is the source of certain products which, when changed by various chemical processes, are capable of yielding coloured derivatives. You will thus perceive that it is important for us to consider the various means employed to obtain the raw materials before giving our attention to the colouring matters themselves. We will, therefore, at once proceed to the consideration of "coal-tar;" its formation and constitution.

Coal-tar consists of the oily fluid formed by the destructive distillation of coal, and is obtained as a secondary product in the manufacture of coal-gas. Originally, coal-tar was a great nuisance to the gas manufacturer, and it was often a problem to him what he should do with it. I need scarcely say that this state of things is now changed. In the gas works the coal is distilled in large retorts, sometimes 25 or 30 feet in length. They are made of fire-clay or iron, and several are arranged in one furnace, or oven, as it is usually termed. Each retort is fitted with an iron mouth-piece, from which a vertical tube rises, the mouth-piece also having a door fastened with a cross-bar and screw.

When in use these retorts are rapidly filled with coal by means of a proper scoop, and then the doors luted and fixed so as to be air-tight. Distillation commences immediately, as the retorts are constantly kept red hot. The gas and other products which form pass up the front vertical pipe (connected with the mouth-piece), through a bend, and down into a long horizontal tube, called the "hydraulic main." Here most of the oily products condense, and as they accumulate pass on with the gas down the general main, and flow into a tank provided for their reception. These oily products constitute "coal-tar." The coal-gas, leaving this tar behind, passes on to the condensers, and deposits a second but smaller quantity of

tar, and is then purified and stored in the gas-holders. The gas, however, does not interest us now.

I am here distilling some coal in a small glass retort, the beak of which is inserted into one of the openings of a three-necked receiver. The second opening is connected with the tube, so that the gaseous products may be examined, whilst the third and lower one is fitted to a small bottle, in which you see we have already obtained a quantity of an oily fluid. This is our coal-tar.

Having now seen how coal-tar is produced, we will consider of what it consists. Coal-tar is by no means a definite body, but contains a great number of different substances, as a glance at the following table will show:—

TABLE I.—PRODUCTS OF THE DISTILLATION OF COAL.

Name.	Formula.	Boiling-point, Centigr.
Hydrogen .. ..	HH	—
Marsh gas (hydride of methyl) .. ..	(CH <sub>3</sub> )H	—
Hydride of hexyl .. ..	(C <sub>6</sub> H <sub>13</sub> )H	65
Hydride of octyl .. ..	(C <sub>8</sub> H <sub>17</sub> )H	106
Hydride of decyl .. ..	(C <sub>10</sub> H <sub>21</sub> )H	158
Olefiant gas (ethylene) .. ..	C <sub>2</sub> H <sub>4</sub>	—
Propylene (tritylene) .. ..	C <sub>3</sub> H <sub>6</sub>	—
Caproylene (hexylene) .. ..	C <sub>6</sub> H <sub>12</sub>	55
Enanthylene (heptylene) .. ..	C <sub>7</sub> H <sub>14</sub>	99
Paraffin .. ..	C <sub>n</sub> H <sub>n</sub>	—
Acetylene .. ..	C <sub>2</sub> H <sub>2</sub>	—
Benzol .. ..	C <sub>6</sub> H <sub>6</sub>	80.8
Parabenzol .. ..	C <sub>6</sub> H <sub>6</sub>	97.5
Toluol .. ..	C <sub>7</sub> H <sub>8</sub>	110
Xylol .. ..	C <sub>8</sub> H <sub>10</sub>	139
Cumol .. ..	C <sub>9</sub> H <sub>12</sub>	148.4
Cymol .. ..	C <sub>10</sub> H <sub>14</sub>	170.7
Naphthalene .. ..	C <sub>10</sub> H <sub>8</sub>	212
Paranaphthalene (anthracene) .. ..	C <sub>14</sub> H <sub>10</sub>	—
Chrysen .. ..	C <sub>18</sub> H <sub>12</sub>	—
Pyren .. ..	C <sub>15</sub> H <sub>10</sub>	—
Water .. ..	{ H } O	100
Hydrosulphuric acid .. ..	{ H } S	—
Hydrosulphocyanic acid .. ..	{ H } S	—
Carbonic oxide .. ..	CO	—
Carbonic anhydride .. ..	CO <sub>2</sub>	—
Bisulphide of carbon .. ..	CS <sub>2</sub>	47
Sulphurous anhydride .. ..	SO <sub>2</sub>	—10
Acetic acid .. ..	{ (C <sub>2</sub> H <sub>3</sub> O) } O	120
Carbolic acid (phenol) .. ..	{ (C <sub>6</sub> H <sub>5</sub> ) } O	188
Cresylic alcohol (cresol) .. ..	{ (C <sub>7</sub> H <sub>7</sub> ) } O	203
Phlorylic alcohol (phlorol) .. ..	{ (C <sub>8</sub> H <sub>9</sub> ) } O	—
Rosolic acid .. ..	C <sub>12</sub> H <sub>12</sub> O <sub>3</sub>	—
Brunolic acid .. ..	—	—
Ammonia .. ..	{ H } N	—33
Aniline .. ..	{ (C <sub>6</sub> H <sub>5</sub> ) } N	182
Pyridine .. ..	(C <sub>5</sub> H <sub>5</sub> )'''N	115
Picoline .. ..	(C <sub>6</sub> H <sub>7</sub> )'''N	134
Lutidine .. ..	(C <sub>7</sub> H <sub>9</sub> )'''N	154
Collidine .. ..	(C <sub>8</sub> H <sub>11</sub> )'''N	170
Parvoline .. ..	(C <sub>9</sub> H <sub>13</sub> )'''N	188
Coridine .. ..	(C <sub>10</sub> H <sub>15</sub> )'''N	211
Rubidine .. ..	(C <sub>11</sub> H <sub>17</sub> )'''N	230
Viridine .. ..	(C <sub>12</sub> H <sub>19</sub> )'''N	251
Leucoline .. ..	(C <sub>9</sub> H <sub>7</sub> )'''N	235
Lepidine .. ..	(C <sub>10</sub> H <sub>9</sub> )'''N	260
Cryptidine .. ..	(C <sub>11</sub> H <sub>11</sub> )'''N	256
Pyrrol .. ..	(C <sub>4</sub> H <sub>5</sub> )'''N	133
Hydrocyanic acid .. ..	HCN	26.5

\* The Cantor lectures, delivered before the Society of Arts.



This list, however, does not indicate all the constituents of coal-tar, but only those which chemists have, up to the present time, succeeded in separating from it; moreover, when we consider how greatly coal differs in composition, and also that the products vary according to the temperature to which the coal has been submitted, it is evident that coal-tar must be an almost endless source of chemical products. Many would, perhaps, consider this list a perfectly hopeless jumble of names impossible to impress upon the memory; but, fortunately, chemists are able to classify their products, so that this formidable array of substances may be grouped under three or four different heads only, and, therefore, their relationship being once understood, little difficulty is experienced in remembering their names.

Amongst these products, and at the lower part of this table, you will observe a substance called "aniline." This substance is of great interest to us, being one of the principal sources of the coal-tar colours. Aniline was discovered by Unverdorben, in 1826, amongst the products of the distillation of indigo, and from its property of forming crystalline compounds with acids was called "crystalline." Afterwards Runge obtained it from the distillation of coal, and, because it gave a blue colouration with a solution of chloride of lime, called it "kyanol," or blue oil. Fritzsche, still later, obtained aniline by the distillation of indigo with hydrate of potassium, and gave it its present name, derived from *anil*, the Portuguese for indigo. About this time Zinin discovered a remarkable reaction, by which he obtained aniline from a substance called nitrobenzol; he called it, however, benzidam. The products obtained by these different chemists were not at first known to be identical; and it was not until Dr. Hofmann investigated the subject that they were all shown to be the same body, aniline.

Zinin's process for the conversion of nitrobenzol into aniline consisted in treating the nitrobenzol with an alcoholic solution of sulphide of ammonium; this was greatly improved upon by Bechamp, who employed a mixture of finely-divided iron and acetic acid, in place of sulphide of ammonium.

This is a brief sketch of the history of aniline up to the time of the discovery of the mauve dye; it was then purely a laboratory product, and was prepared in very small quantities at the time, and only when required for scientific research. Chemists have always been desirous of producing natural organic bodies artificially, and have in many instances been successful. It was while trying to solve one of these questions that I discovered the "mauve." I was endeavouring to convert an artificial base into the natural alkaloid quinine, but my experiment, instead of yielding the colourless quinine, gave a reddish powder. With a desire to understand this peculiar result, a different base of more simple construction was selected, viz., aniline, and in this case I obtained a perfectly black product; this was purified and dried, and when digested with spirits of wine gave the mauve dye.

You will perceive that this discovery did not in any way originate from a desire to produce a colouring matter, as is sometimes stated, but in experiments of a purely theoretical nature.

After showing this colouring matter to several friends, I was advised to consider the possibility of manufacturing it upon the large scale, and was eventually, induced to make the experiment, though, I must confess, not without considerable fear of the result, especially as my chemical advisers set before me anything but encouraging prospects. In starting this manufacture, the first difficulty was to decide upon the source from which aniline could be obtained at a sufficiently low price. It was at once evident that indigo was by far too costly a product for this purpose. Attention was, therefore, directed to the extraction of aniline from coal-tar, but after very numerous experiments, it was found that the difficulty of purifying it was so great, that it was not practicable to prepare it at a reasonable price from this product. There was, therefore, but one

source left, namely, nitrobenzol; but to prepare aniline from this body necessitated the establishment of a new manufacture; nitrobenzol at that time not being a commercial article, and although it could be produced in small quantities without much difficulty, yet when tons were required at a limited cost many obstacles presented themselves.

Having spoken of nitrobenzol, it will be necessary, before proceeding further, to tell you something of the body it is prepared from, and also how it is made in quantity. Nitrobenzol is produced from a derivative of coal-tar called benzol—you will see it mentioned in the list of coal-tar products. It is composed exclusively of carbon and hydrogen, and is, therefore, called a hydrocarbon.

Benzol was discovered by Faraday, in 1825, one year before aniline by Unverdorben. Its existence in coal-tar was first pointed out by Dr. Hofmann, in 1845, and afterwards Mansfield showed that an almost unlimited supply might be obtained from this source. Benzol is a volatile oil, boiling at a temperature of 80.8°C., nearly 20° lower than water, and is also very inflammable, burning with a smoky flame. When ignited it cannot be extinguished by water, as it floats upon its surface. Its vapour, when mixed with air, is explosive. It is also very dense. This I can easily show you by decanting a small quantity of benzol vapour several times from one vessel into another, and then igniting it. Instances have been known, when distilling benzol in large quantities, and some leak in the apparatus has occurred, so that its vapour has escaped, that it has run along the ground, and been ignited by a furnace situated thirty or forty feet distant, and instantly run back to the apparatus. To illustrate this I will pour some benzol vapour into the top of a slightly inclined trough, fourteen feet long, at the lower end of which is placed a lamp. The vapour will be seen to run gradually down till it reaches the lamp, where it ignites and instantly rushes back to the top of the trough. One of the most remarkable properties of benzol is, that when cooled down to nearly the freezing point of water, it solidifies to a beautiful crystalline mass. This property of benzol is sometimes taken advantage of when it is required in a very pure state, as the impurities which accompany it are fluid, and do not freeze when cooled with ice.

Benzol is often sold under the name of benzine collas, for the purpose of removing grease from wearing apparel. But let us consider how benzol is separated from the great number of products with which it is associated in coal-tar. The first operation consists in distilling the coal-tar, just as it comes from the gas-works, in large stills, holding one or two thousand gallons each; these are often made of old steam-boilers; at first very volatile and light oily products come over, and are collected until their density increases to such an extent that they no longer float upon water. These constitute crude coal-tar naphtha. The distillation is then carried on, and heavy, or, as they are technically termed "dead," oils, are collected, a residue of common pitch being left in the still. This pitch is generally run out, and cast into blocks; but sometimes the distillation is carried on after the dead oils have been obtained, when a mixture of solid oily products distils, nothing but a kind of coke being left behind. These latter substances, however, do not interest us now.

The light oil, or crude coal-tar naphtha, is then purified by one or two alternate distillations with steam and treatments with concentrated sulphuric acid. It is thus rendered a colourless fluid. Thus purified, coal-tar naphtha contains, besides benzol, at least four or five other bodies. These, however, mostly differ from benzol in being less volatile; therefore, the naphtha is again distilled, the first, or more volatile, portions only being collected for benzol. By repeating this process of fractional distillation several times, commercial benzol is obtained. Some manufacturers employ stills of a peculiar construction, which enables them to obtain a good product



by a smaller number of distillations. Benzol, when treated with fuming nitric acid or aquafortis, undergoes a remarkable change. At first the two fluids mix and become of a dark brown colour and slightly warm, in the course of a few moments red fumes appear, and the mixture enters into ebullition. During this violent action the colour of the liquid becomes lighter and ultimately changes to orange. If water be now added to this product, the benzol, which is such a light body, will be seen to have completely changed into a dense yellow oil sinking in water. This oil is nitrobenzol. Nitrobenzol was discovered in 1834, by Mitscherlich. It solidifies into a crystalline mass at a temperature of about  $3^{\circ}$  C.; its odour is like that of the oil of bitter almonds, and before the introduction of coal-tar colours it was made in small quantities, and sold under the name of essence de Myrbane, for the purpose of scenting soap.

From the energy with which benzol is attacked by fuming nitric acid, nitrobenzol at first appeared to be a most difficult product to manufacture on the large scale, and this difficulty seemed the greater when it was found necessary that it should be made at a moderate cost. Moreover, at the time I am now referring to, fuming nitric acid, sp. gr. 1.5, could not be obtained in the market, or only at such a cost as almost to preclude its use. Under these circumstances, two mixtures were experimented with instead of the nitric acid in a very concentrated condition. The first was a mixture of nitrate of sodium and sulphuric acid, the second a mixture of ordinary nitric acid, sp. gr. 1.3, and sulphuric acid. The mixture of sulphuric acid and nitrate of sodium was preferred, and employed on the large scale.

(To be continued.)

## NOTICES OF BOOKS.

*On the Manufacture of Beet-Root Sugar in England and Ireland.* By WILLIAM CROOKES, F.R.S., &c. Illustrated with Ten Engravings. London: Longmans, Green, and Co. 1870.

WHILE we cannot, for obvious reasons, pronounce an opinion on the merits or demerits of this book, we may perhaps be allowed to say that the author's aim has been to give, in a convenient-sized volume, all the information and statistics necessary for the culture of the beet and the establishment of beet-sugar manufactories.

The subjects treated of are:—The Culture of the Beet; Technology of the Beet-Sugar Manufacture; the Chemistry of Beet-Root Sugar, Juice and Molasses; Filtration and Concentration of the Juice; Decolourising the Syrup; Water Supply; the Concreting Process; the Utilisation of the Spent Beet-Root Pulp; the Manufacture of Spirit from Beet-Juice; the Sucrate of Lime Process; Manufacture of Potash Salts; Excise Regulations; Percentage of Sugar in Different Kinds of Beet; Yield per Acre; Description of Dr. C. Schiebler's Calcimeter, or Apparatus for the Quantitative Estimation of the Carbonate of Lime in Bone-Black by Volumetrical Assay.

It is certainly a cause for astonishment that a country ranking high in agriculture, and highest in everything relating to manufacturing appliances, should have hitherto kept far behind Continental agriculturists in the successful prosecution of this industry; a fact the more to be wondered at since the spent beet-root pulp is even a better food for cattle than the root crops so extensively cultivated for that purpose. Excepting the central and northern parts of Scotland, and the high moor-grounds, the United Kingdom is as favourably situated for the cultivation of the sugar-beet as any portion of the European Continent; whilst the higher standard of agricultural efficiency in this country would greatly tend to secure good crops with existing systems of rotation. That agricultural labourers can be readily taught the routine of the

manufacture is evidenced by Continental experience; and the skilled supervision does not require more than, at the utmost, half a dozen men.

The Chancellor of the Exchequer, in his recent speech on the Budget, when introducing the subject of the partial remission of the sugar duties, said:—"We know that the beet-root industry of the Continent seems to have got over its difficulties, and to be spreading very widely. There is also the prospect of the growth of beet-root, with this object, in our own country; and, if we could hope for anything so good as that it should be introduced with success into the south of Ireland, it would be one of the greatest blessings that could possibly befall that country." The sugar-beet has been grown experimentally in various parts of the county of Kilkenny, by the Hon. L. Agar Ellis, M.P.; and the important result has been established that the climate of the south-east of Ireland is suitable for the growth of such a crop, and that sugar-beet can there be grown of a quality which will remunerate the manufacturer. It is calculated that a proportion of 8.5 of crystallisable sugar will pay; and, in some instances, comprised within the range of the experiments, there was a yield of 10.91 and of 8.94. Mr. Ellis observes that, to make the crop worth growing, either the present sugar-refiners of Ireland must put up machinery for "converting" it, or separate districts must erect the necessary works. That the magnitude of the industry is sufficient to warrant operations on the largest scale is shown by the fact that last year France alone produced no less than 300,000 tons of beet-sugar, which, at £25 per ton, would be worth £7,500,000, the molasses (100,000 tons at £5) bringing up the value to £8,000,000. Beet-root may yet redress the injury inflicted on Ireland by the potato.

As some remarks were recently made in our journal respecting Dr. Schiebler's calcimeter, we propose, in our next number, to give a full description of the instrument, together with the woodcut as it appears in the above work.

*Abridgments of Specifications Relating to Aëronautics.* A.D. 1815—1866. London: Messrs. Spottiswoode. 1869.

WITH indefatigable zeal the gentlemen who are the active workers under the Commissioners of Patents proceed in the laudable work of compiling and publishing the series of useful works, of which the above is the forty-first already issued for public use.

The little volume before us is especially interesting, because the introduction contains the history of aëronautics, set forth in a lucid and clear manner, so as to show the connecting-links that bind together the history of this subject.

After referring to the ideas expressed in the fables of the Ancients, and the accounts of Icarus and Dædalus, to show that mankind always had in view the possibility of elevating themselves in the air, the author says:—"The term aëronautics is rather in advance of the condition of the subject at the present day, since no means are known by which a heavy body may be elevated into the air, and navigated as a ship is on the sea. The utmost that has been done is to take advantage of the different aërial currents that exist at a given time at various elevations, and, by raising and lowering a gas-balloon accordingly, to approximate to the desired direction. The various methods (many proposed, and a few realised) that have the accomplishment of aërial navigation for their object may be classified thus:—Kites; fire-balloons; hydrogen-balloons; coal-gas balloons; mechanical apparatus."

The author next briefly alludes to the history of each of the matters just specified, calling attention to the very great antiquity of the use of kites for amusement among the Chinese and Japanese; and explains the term fire-balloons from the well-known fact that the ascent of these balloons is due to the rarefaction of the air caused by



the fire which is kept burning beneath them. This is effected usually by a sponge dipped in strong spirits of wine. This mode of letting up balloons, having become rather a general amusement on some parts of the Continent, was forbidden by the authorities, on the ground that the falling-down of these fire-balloons (which often became ignited, and burst into flames) gave rise to fires, especially in country districts. The mechanical means of flight is at present only represented by a toy called the "aërial top," which has light, but strong, blades attached, at a certain acute angle, to its axis.

We next meet with a brief chronological summary of the history of this subject, beginning with Archytas (400 B.C.), who constructed a wooden pigeon which could fly by mechanical means, up to our day, relating Mr. J. Glaisher's researches. This summary aims at the registration of scientific data, not a collection of ascents; and is, therefore, of very great value. Attention is drawn to the very complete series of works on aëronautics, accessible to the public, at the Patent Office Library; and, among these, to a most valuable manuscript work, entitled, "Aëronautica Illustrata," an extensive and valuable collection of writings, illustrations, and original documents that have been collected and arranged in the course of years.

Space forbids us to enter into more particulars; but the compiler and the author of the introduction to this neat little volume deserve great credit for their work. And, since the price (sixty pages) is only 4d., we abstain from further details, but recommend the volume, not only for amusing, but also for instructive, reading.

## CORRESPONDENCE.

### ERECTING PRISM.

*To the Editor of the Chemical News.*

SIR,—Referring to Mr. Browning's reclamation in the CHEMICAL NEWS, vol. xxi., p. 264, in which he mentions that he made one of these prisms "two or three years since," allow me to mention that a full account of the arrangement (in fact, the article published in the CHEMICAL NEWS, vol. xxi., p. 246), appeared in the *Journal of the Franklin Institute*, for June, 1867.

The prism had been exhibited at the meeting of the Institute in the previous month and was made some time before,\* so that, taking the earliest of Mr. Browning's dates, this is another of those remarkable instances of coincidence in ideas regardless of distance which are so often met with.

HENRY MORTON.

## MISCELLANEOUS.

University of London (D.Sc. Examination).—Branch I. (*Mathematics*)—John Hopkinson, Trinity Coll., Camb., and Owen's. Branch IV. (*Inorganic and Organic Chemistry or Mineralogy*)—James Bottomley, B.A., Owen's College; David Watson, Royal School of Mines; John Watts, private study. Branch V. (*Organic and Inorganic Chemistry*)—James Campbell Brown, Royal College of Chemistry and private study; Charles Romley Alder Wright, Owen's College. Branch VIII. (*Physical Optics, Heat, Acoustics*)—John Hopkinson, Trinity Coll., Camb., and Owen's.

Royal School of Mines.—After a meeting of the Council, held on Saturday, the 2nd inst., the results of the

examinations for the year were announced as follows:—*Third Year's Students*—Associates in Mining, Messrs. W. Gowland, Archibald Liversidge, and H. J. Renwick; in Metallurgy, W. Gowland, Dillon, Liversidge, W. W. Bickerton, F. W. Bailey, and T. Jones; in Geology, W. Johnson Sollas. Medals—De la Beche Medal and Prize of Books to W. Gowland. *Second Year's Students*—H.R.H. Duke of Cornwall's Scholarship of £30 for two years, to P. C. Gilchrist; Royal Scholarship, £25, for one year, to R. R. Atkinson; Sir Roderick Murchison's Medal and Prize of Books, to P. C. Gilchrist. *First Year's Student*—Royal Scholarship of £15, for one year to (1.) W. H. Greenwood, and (2.) F. C. Mitford.

The Franklin Institute.—At a recent meeting of this Institute, Professor Morton resigned the office of Resident Secretary, he having accepted an appointment in a distant city. The resignation was accepted, and the President stated that Professor Morton had consented to continue his charge of the *Journal of the Franklin Institute*, which had achieved so desirable a position under his management. The new position accepted by Professor Morton is that of President of a College of Mechanical Engineering, to be established in Hoboken, opposite New York. He is succeeded at the Institute by Dr. W. H. Wahl.

Magic-Lantern Pictures on Gelatine by a New Method.\*—At the last meeting of the Franklin Institute, the Resident Secretary, Professor Morton, exhibited in the lantern some pictures on gelatine, prepared in a manner devised by Mr. Sheperd Holman, a member of the Institute. For this purpose a sheet of gelatine, such as is used for tracing by engravers, was securely fixed over an engraving, and with a sharp steel point (made by grinding down the end of a small round file), the lines of the original traced pretty deeply on the transparent substance. Lead-pencil or crayon dust was then lightly rubbed in with the finger, and the picture was at once ready for use. A number of such drawings could be easily carried between the leaves of a book, each in succession being held in a frame or cell made of two plates of glass separated by a frame of thin card or three edges, and united by paper or muslin pasted around the same edges. The effect of these drawings in the lantern was excellent, and their ease of production very great.—*Journal of the Franklin Institute*.

A New Artificial Light.—The *Berggeist* describes a new artificial light which has recently been successfully experimented with. It is the Philipp carbo-oxygen lamp, and its trial during the month of March, at Cologne, was such as to win approval on every hand. The system of lighting is distinguished from those already in existence by its simplicity, its brilliancy, and, moreover, by its less noxious character. The light is generated by the simultaneous combustion of a liquid chemical compound and a current of oxygen, arrangements for the purpose being constructed in a suitable lamp. The gas is derived from the atmosphere either by chemical or mechanical means; the chemical methods being to act upon the oxygen of the air with chloride of copper (Mallett's method), or with manganate of potash (Tessie du Mothay's method), while the mechanical mode is that of utilising the different degrees of solubility of nitrogen and oxygen in water or other liquids. By compressing atmospheric air into receivers filled with water, a portion of the nitrogen is taken up by the water, while the oxygen remains insoluble in the water; the air, thus containing a goodly proportion of oxygen, is forced into a second reservoir of water, where a further amount of nitrogen is absorbed, and after the operation has been repeated seven or eight times, an atmosphere is obtained containing 97 per cent of oxygen. The nitrogen which has been separated is made use of in a well-constructed apparatus, as an auxiliary to the motive force. Experiments have established the fact that a flame fed with air containing 53 per cent of oxygen

\* The charges against me on Mr. Zentmayer's books for the prism then used being dated March, 1867, while a smaller one, not charged, was made some months before.

\* Communicated by Professor Morton.



yields a light equal in brilliancy to that obtained with pure oxygen, and with diluted oxygen of this kind the Philipp flame has a brilliancy of 90 to 100 candles, or ten times that of an ordinary gas jet. The light is of a bluish white, resembling very much that of electricity and magnesium. The liquid employed consists of liquid hydrocarbons, very rich in carbon; it costs but little, burns economically, and can be employed only in this particular direction. The combustion is maintained in a lamp—Philipp's carbo-oxygen lamp—fitted with a wick, into the flame of which the oxygen penetrates in a horizontal direction. The flame is thus made to assume the form of a star, and any heating of the wick-holder thereby prevented; if of the size and power above mentioned, the quantity of gas consumed is  $5\frac{1}{2}$  cubic feet per hour. As to the lamp, no special attention is necessary beyond that of filling it with liquid, as the wick is of a very durable nature, and needs no trimming. The hydro-carbon employed is patented both in Europe and in America. This method of lighting is, we believe, likely to be adopted very widely. Independently of its simplicity and reasonable cost, which are, indeed, extreme, it possesses the very eminent and valuable qualifications of perfect security; no explosion is in any way possible, such as not unfrequently occurs with ordinary coal gas and with hydrogen. The costly trials undertaken by Tessie du Mothay, inaugurated at the exhibition of 1866, made a profound sensation at the time, and were regarded with considerable favour, although the apparatus employed was of a very costly description, and it was necessary to employ for the purpose two gases exceedingly dangerous to manipulate, which were brought through a double series of tubes, the one for ordinary gas, and the other for oxygen; the apparatus itself, moreover, necessitated a careful and continued superintendence. All these inconveniences disappear with the new carbo-oxygen system, which, besides its application to industrial purposes—the navy, railways, military operations, &c.—will be wonderfully well suited to photographic purposes, as has, indeed, been proved by the attainment of some very remarkable results. The *Berggeist* concludes by saying that a method of lighting endowed with such important qualifications as the lamp invented by M. Philipp cannot remain long before being extensively known throughout the world.—*The Photographic News*.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopaedic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "*Jahresberichte*."

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

*Comptes Rendus des Séances de l'Académie des Sciences*, June 20, 1870.

Omitting papers more strictly bearing upon mathematical, natural history, and mechanical subjects, this number contains the following papers and memoirs relating to physico-chemical science:—

Variations of Temperature Produced by the Mixing of Two Different Liquids.—M. Jamin.

Observations and Remarks on this Memoir.—J. Bussy.—The contents of these papers are chiefly speculative; and, as regards the latter paper, the author points out several discrepancies which exist between the results obtained by his experiments on this subject, and those of the first-named author.

Electric Effects Produced by the Contact of Non-Oxidisable Metals with Acids, Neutral and Saturated Saline Solutions, and on Capillary Affinity.—Prof. Becquerel.—In this paper, only published in abstract, the author describes the electric phenomena

observed when pure gold and platinum are immersed in various acids, ammonia, and neutral saline solutions, which do not exercise any action at all upon the metals alluded to. The main conclusion arrived at by the author is, that the state of the surface of the metals has great influence, and that, consequently, capillary affinity plays a very important part in the production of the electric phenomena (very feeble currents) produced.

Reversal of the Two Lines of Sodium in the Spectrum of the Light Produced by one of the Protuberances of the Sun.—G. Rayet.—Illustrated with diagrams.

Estimation of the Absolute Value of the Intensity of the Terrestrial Magnetism.—A. Cornu and J. Baille.

Experimental Researches on the Length of Duration of the Electric Spark.—MM. Lucas and Cazin.—The authors employ two transparent discs placed upon the same axis. One of these discs is a fixture, while a more or less rapid rotatory motion can be imparted to the other. Upon both discs are painted the same number of opaque stripes, in the direction of the radius. When, therefore, an electric spark is observed through these discs, a certain amount of speed having been imparted to the movable one (the apparatus being placed in a darkened room), it is clear that, by the light emitted by the spark, a certain number of coincidences of the movable and fixed stripes may be observed, and these coincidences may serve to calculate the period of duration of the spark.

Precipitation of Muddy Matter from Water by the Aid of Dilute Saline Solutions.—Dr. Ch. Schläesing.—The author states that water, otherwise pure, but contaminated simply with clay (as may be the case with the water of rivers after heavy rain or fall of snow), becomes at once clarified by very minute quantities of some salts of lime. 1-1000th part of chloride of calcium for 1 part of water effects this purpose in a moment; the nitrate, bicarbonate, and caustic lime act in the same manner. The precipitated substance may be readily separated from the water by filtration, whereas the filtration of the water containing the suspended matter is very difficult, because the pores of the filters are choked. The practical importance of this matter is very great, since it is, for instance, a well-known fact that the water of some rivers (the Durance being notorious in this respect) does not, in winter time, and after heavy rainfall or snow-storms, become quite clear, even if left at rest in large ponds for a considerable time. The same is the case with the water of the Rhine, which, in its lower course, is often quite turbid for weeks together, simply from the effects of very finely-divided clay being kept suspended, even after the water has been at rest in tanks. The water of the river Durance supplies Marseilles with fresh water, the latter being brought to that city by a magnificent series of works, among which the celebrated Aqueduc de Roquefavour. The use of chloride of calcium is, however good, not indispensable; and our readers may be reminded here that the late Prof. Johnston, of Durham University, has very ably and fully explained the clearing of muddy, and thereby non-potable, water in his work, "*Chemistry of Common Life*," wherein he has also made reference to the use of certain bitter vegetable substances which have been applied, both in Egypt and in India, for the purpose of rendering the waters of the Nile, Ganges, Indus, and other large rivers, potable, many centuries before the *rationale* of the action of these substances was understood.

Law of Freezing-Points of Saline Solutions.—Dr. Güldberg.—An algebraico-physico-chemical essay.

Composition of Crude Soda; and on the Loss of Sodium resulting from its Manufacture according to Le Blanc's Process.—A. Scheurer-Kestner.—Although we reserve this highly-important paper bearing upon the manufacture of soda for full translation at a future date, we here quote that, while it is a well-known fact that, in practice on the large scale, a loss of from 15—20 per cent from the theoretical yield is experienced, the author has ascertained that the main cause of this loss (some of these causes are well known already) is the formation of insoluble (in water) sodic combinations, which remain in the lixiviated refuse. Volatilisation of sodium does not take place appreciably.

Rapid and New Method of Quantitative Estimation of Ammoniacal Salts; on the Causes which Prevent the Existence of these Salts in the Human Organism in other than Infinitesimally-Small Quantity.—Dr. Rabuteau.—The author prepares a solution of eau de Javelle (*chlorure de soude*, strictly a more or less pure hypochlorite of soda), by mixing, with a solution of 1 part of bleaching powder (hypochlorite of lime), a solution of 2 parts of carbonate of soda. The solution so obtained, containing, besides, excess of carbonate of soda, or free soda, is applied for the decomposition of the ammoniacal salts, so that nitrogen is set free. The remainder of the contents of this paper is strictly physiological, and the intention, as regards the application of the test liquid, is for the use of physicians in practice more than for the chemist.

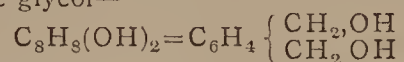
Tribromhydrines.—Dr. Berthelot.—A lengthy memoir containing a series of critical remarks and observations on the last paper on this subject, by Dr. Henry, published in this periodical.

Preparation of Bibromated Ethylen.—Dr. Fontaine.—After referring, at great length, to the labours of several experimenters on this subject, and pointing out the incompleteness of their modes of preparation of the body alluded to, the author states that bibromated ethylen may be obtained without any evolution of gas, by pouring into bromated bibromide of ethylen,  $C_2H_3Br.Br_2$ , kept well cooled, an alcoholic solution of caustic potassa, care being taken to avoid any increase of temperature. As soon as the liquid has become thoroughly alkaline, water is added, and the bibromated ethylen separated by decantation.

On an Aromatic Glycol.—E. Grimaux.—The author of this long



paper describes the reactions by means of which he has succeeded in obtaining the tollylic-glycol—



This body fuses at about  $113^\circ$ ; is very soluble in water, alcohol, and ether; and crystallises in needles. Heated with hydrochloric acid, it is converted into chloride of tollylen.

**Dust- and Blood-Rains.**—H. Tarry.—A very lengthy and interesting memoir on this subject, proving the true origin of these phenomena.

**Notes relating to the Magnetic Perturbations observed by De Saussure while Sojourning on the Col du Géant, which Perturbations preceded the Terrible Hail- and Thunder-Storms which occurred during the year 1788.**—C. Dufour.—The Col du Géant, at 3426 metres above sea level, is a portion of the Alps. The author of this paper calls attention to the relation which appears to have existed, but was not (as far, at least, as his own records prove) observed or noticed by the late De Saussure, between the severe perturbations of the magnetical instruments he had with him at the locality alluded to, and the exceedingly severe hail- and thunder-storm which followed the very next day (July 13th, 1788) of these perturbations, over a large portion of Europe, from the north of Spain to the Baltic. The author of this paper calls attention to these old observations (the Aurora Borealis was also seen faintly at the Col du Géant at the time); because, as noticed this year, the phenomenon last alluded to was immediately followed by several *bourrasques* bursting over Europe. By *bourrasques* are meant severe perturbations of the air, often accompanied by hail, thunder, heavy rains, and always high wind, if not, in some localities, hurricane.

June 27, 1870.

This number contains the following memoirs and papers bearing upon chemistry and collateral sciences:—

**Observations and Remarks on M. Jamin's Paper "On the Variations of Temperature Produced by the Mixture of Two Liquids."**—H. Sainte-Claire Deville.—The author, pursuing his course of combating hypothesis, attacks, in this paper, several of the statements made by M. Jamin, and especially points out the perfect uselessness of the idea of an absolute zero to explain the phenomena relating to the specific heat and free caloric.

**Researches on some New Derivatives from Triethyl-Phosphine.**—A. Cahours and H. Gal.—After referring to their former researches on this subject, the authors describe several new compounds of triethyl-phosphine and chloride of platinum, among which we notice a body composed according to the formula,  $[\text{Ph}(\text{C}_2\text{H}_5)_3]_2\text{PtCl}$ , a prismatically-crystallised, colourless substance, corresponding to Reiset's salt,  $(\text{NH}_3)_2\text{PtCl}$ . The triethyl-phosphine compound alluded to is decomposed at  $100^\circ$ , losing one equivalent of triethyl-phosphine. The authors have also produced compounds of the chlorides of gold and palladium with triethyl-phosphine, which, according to their researches, act towards the chlorides alluded to in a manner akin to the behaviour of ammonia with these chlorides.

**Galvanical Deposition of Nickel.**—H. Bouillet.—The author states that the assertion of M. Adams, in reference to the necessity of having the nickel solution absolutely free from alkalies and alkaline earths, is quite incorrect; and, in proof thereof, the author exhibits a perfectly coherent piece of nickel, obtained by Professor Jacobi, of St. Petersburg, from the double sulphate of nickel and magnesia, by the use of a nickel anode, which, curiously enough, is not entirely dissolved, but converted into a spongy suboxide of nickel.

**Direction of Induction Currents obtained by the aid of Electrical Discharges.**—J. Chautard.

**New and Generally-Applicable Method for the Preparation of Organic Chloro-Bromated Compounds.**—L. Henry.—The author states that, having read of Dr. Friedel's researches on the preparation of chlorobromides of the biatomic hydrocarbons, he has made some experiments with the chloro-iodide of ethylene,  $(\text{C}_2\text{H}_4)\text{ICl}$ , and with the chloro-iodhydride of allyl,  $(\text{C}_3\text{H}_5)(\text{HO})\text{ICl}$ , which, by the action of bromine, are converted into chloro-bromated compounds. The author continues his researches on this subject.

**Silico-Propionic Acid.**—C. Friedel and A. Ladenburg.—While organic chemistry is aptly called (say the authors) the chemistry of carbon, we are engaged in researches which tend to place silicium parallel to the former element. What is called silico-propionic acid,  $\text{SiC}_2\text{H}_5\text{O}_2\text{H}$ , is a compound wherein a large percentage of the carbon of propionic acid is replaced by silicium. The physical aspect, and many of the properties of this body, are akin to silica; but it is a combustible substance, insoluble in water, but soluble in a hot and concentrated solution of caustic potassa. M. Dumas observed, during the meeting, at which this paper was read, that it is not impossible that there exist in nature organic compounds of silica, a remark which gave rise to the following paper:—

**Observations on Dr. Friedel's Memoir.**—P. Thenard.—The author begins with stating that M. Dumas is quite right, and relates, further, that he (M. Thenard) is at present engaged on researches of organic acids which contain even 24 per cent of silica entirely disguised. When ulmic acid is treated by ammonia, azhumic acid is formed; this contains nitrogen so fixedly, that it is only eliminated at a temperature of about  $1200^\circ$ . This acid is possessed of the remarkable property of readily dissolving silica and combining therewith, in the same manner as the compound alluded to above by Dr. Friedel. The author also states that, although his researches on this subject are not yet quite concluded, he is justified in stating that all arable and garden soil, and, far more so, farm-yard manure, contain similar organic

siliceous compounds, which play an important part in the feeding of the plants.

**Phospho-Platinic Compounds.**—P. Schützenberger.—Mainly a collection of lengthy formulæ.

**Existence of Organic Remains in Rocks supposed to be of Igneous Origin.**—C. Montagna.—The author replies to the critical remarks made by several German and Russian geologists on his theory of the formation of the so-called igneous rocks, about which he published some papers a couple of years ago. He says that the fossils discovered by him, and deposited in his collection at Naples, are not microscopic objects, but so large as to attract even the attention of the wayfaring people who happen to pass by the spot (near Naples) where they are found.

**Electric Condensation.**—M. Neyreneuf.

*Bulletin de l'Académie Royale des Sciences, des Lettres et des Beaux Arts de Belgique*, No. 4, 1870.

The only paper relating to the physico-chemical sciences in this number is—

**Superficial Viscosity of Thin Sheets of Saponine Solution.**—C. Van der Mensbrugghe.—The author describes, and illustrates by a cut, an experiment wherein the electrical repulsion aids the superficial viscosity of a solution of saponine to keep an open space between the thin sheet of that substance, notwithstanding the tendency of the capillary action to close that opening.

*Annales de Chimie et de Physique*, May, 1870.

This number contains the following original memoirs and papers:—

**On Collision.**—A. Dupré.—A very exhaustive and lengthy mechanico-mathematical paper.

**Researches on the Gaseous Products of the Combustion of Coal.**—A. Scheurer-Kestner.—We regret that, owing to the absolute necessity of the woodcuts added to this paper for understanding its contents, we cannot enter into details on this scientifically as well as practically-interesting subject. The author's experiments confirm those made, now many years since, at Elswick (near Newcastle-on-Tyne), by Sir William Armstrong, Mr. J. A. Longridge, and the late Dr. T. Richardson, as far as regards the combustion of fuel without smoke also having the effect of eliminating from the chimney-gases those which are combustible.

**Influence Exercised by Magnetism on Electric Jets Propagated in Partially-Vacuous Space.**—A. De la Rive.

*Polytechnisches Journal von Dingler*, second number for May, 1870.

This number contains the following original papers relating to chemistry and collateral sciences:—

**Changes Coal undergoes by Exposure to Air.**—Dr. T. Richters.—The concluding part of this very lengthy paper; this portion treats on the so-called weathering of coals. The author has added to this excellent paper a review in tabulated shape, containing the results of analysis (quantitative estimation of carbon, hydrogen, oxygen, nitrogen, ash, coke, heating effect, and specific gravity) of various kinds of coals freshly taken from the pit, and after variable periods of exposure to air.

**Lime and Cement.**—W. Wolters. This paper treats mainly on the causes of the so-called binding and hardening of what is generally known as mortar, viz., the mixture of sand, water, and slaked-lime; the paper is divided into the following sections:—Slaking of lime; the binding; behaviour towards carbonic acid; gypsum (plaster of Paris); and sulphate of potassa.

**Tin which has been Exposed to a Great Degree of Cold at St. Petersburg.**—P. Lewald.—The author referring to the phenomenon first observed by Dr. Fritzsche, says, it is not at all a correct statement that the blocks of tin exposed to a cold of  $-35^\circ$  should alter their state of aggregation from that cause; the real cause is that the blocks of tin, usually of 250 cubic inches capacity, are cast in iron moulds and, as a consequence thereof, the metal (tin) contracts unequally and so as to leave in the inside of the blocks cavities often so large as to occupy 40 cubic inches; these hollows are lined by a crystallised metal at a high degree of tension. The tin at St. Petersburg was laying heaped block upon block, and the effect of the cold was simply a remote cause to what took place, the weight of the blocks of metal placed on each other being such as to produce necessarily a pressure too great to be borne by the undermost blocks. The author says, if tin is molten and allowed to cool, so as to shrink uniformly, no cold, even of  $40^\circ$  or less, will have the effect observed in the locality alluded to.

*Neues Jahrbuch für Pharmacie*, von Dr. F. Vorwerk, April, 1870.

This number contains the following original papers:—

**Mineral Springs met with in the Neighbourhood of Chur (Switzerland).**—Dr. A. Husemann.—Some parts of the Helvetian Republic, and especially the Canton des Grisons, abound with valuable mineral-water springs. The springs of Passug, discovered in 1863



the water of the most prominent of these springs was analysed by Dr. A. von Planta-Reichenau. The locality where these springs are found is about 830 metres above sea level. The result of the analysis of the most important of the springs (Ulricus spring) is—Temperature of water, 8.1 (the temperature of the air being 4.4 at the time of observation); sp. gr., 1.007. 1000 parts of the water contain—Chloride of sodium, 0.8493; iodide of sodium, 0.0008; sulphate of potassa, 0.1568; sulphate of soda, 0.0862; carbonate of soda, 3.7879; carbonate of lime, 0.7126; carbonate of magnesia, 0.3786; carbonate of protoxide of iron, 0.0102; phosphate of alumina, 0.0074; silica, 0.0190; traces of manganese, lithia, and strontia; free carbonic acid, 1.8982. The Theophilus spring, saline chalybeate, contains, in 1000 parts—Solid and gaseous matter, 5.9524. The Fortunatus spring, a saline water very akin to that of the Ulricus spring, contains, in 1000 parts—Fixed and gaseous matter, 8.5391. The author describes further, at length, the Belvedra springs and the Castiel springs; the water of the former is salino-chalybeate; that of the latter, alkalino-chalybeate, and its composition very closely resembles the well-known Selters water from Nieder-Selters in the Province of Nassau (Prussia).

**Purification of the Hydrate of Chloral.**—F. A. Flückiger.—The main gist of this paper is that, for medicinal use, the re-crystallised hydrate of chloral alone is suited, while the author recommends, as the best solvent from which to obtain the hydrate in crystalline state, purified sulphide of carbon, the last traces of which are removed from the crystals by a moderately-strong current of cold air.

**Experiments on the Production of Sulphuric Acid from Gypsum.**—H. Reinsch.—A quintal (hundredweight) of gypsum,  $\text{CaO}, \text{SO}_3, 2\text{H}_2\text{O}$ , contains about 57 lbs. of sulphuric acid (so-called English). The author, after referring to the very many hitherto unsuccessful attempts made to obtain this acid from this most abundantly-found mineral, states that, when he mixed 2 parts of pulverised gypsum with 1 part of carbonate of ammonia, and poured water over this mixture, complete decomposition of the gypsum ensues, sulphate of ammonia is formed, and carbonate of lime. The sulphate of ammonia is, in its turn, decomposed by means of common salt, the result being the formation of sulphate of soda and chloride of ammonium, which can again be converted into carbonate of ammonia by means of chalk.

**New Researches on Calisay Bark from Java.**—J. B. C. Moens.—The author communicates the results of his researches of ten species of *Calisaya dubia*, and two of *Calisaya vera*. The freshly-cut bark contains 64 per cent of water, and when air-dried about 13 per cent. The quantity per cent of all alkaloids together in the ten first-named species varies from 2.465 to 6.010. The quinine varies in quantity from 0.589 to 2.831 per cent. The cinchonidine (not met with in all the barks) is present in quantities from 0.539 to 2.41; the quantity of cinchonine varies from 1.405 to 3.909 per cent. The barks of *Calisaya vera* contained, respectively, 7.442 and 7.482 per cent of alkaloids; the quinine amounted to 3.670 per cent, and the cinchonine to 2.812 per cent. The barks alluded to contain, on an average, after having been dried at 125°, 2.332 per cent of ash, of which 0.728 per cent is lime.

*Zeitschrift für Chemie von Beilstein*, No. 10, 1870.

The number opens with—

**Die Königlich Rheinisch-Westphälische Polytechnische Schule zu Aachen** (that is to say—A Full Programme of the Royal Rhenish-Westphalian Polytechnic School at Aix-la-Chapelle).—This establishment, to be opened on the 10th of October next is, says the programme, intended to be a technical high school of the same kind as the Polytechnic School at Hanover, the Architectural Academy and Technical School at Berlin, and a combination of the Ecole Polytechnique, Ecole des Mines, and Ecole Centrale des Arts et des Manufactures at Paris. The main subjects of ordinary instruction are fifty-eight in number, and, beside this, lectures on thirteen extraordinary subjects will be given; in fact, as might be expected from the Prussian Government, the establishment is in every respect complete. The building is an imposing and beautiful one, of large dimensions, fitted up with all the requisites for this purpose. It has been erected in a city, the best which could be selected in Rhenish Prussia, since it is readily accessible, and its situation is healthy; and, what is of more importance, it is eminently the centre of a large manufacturing, mining, and, technically, highly-developed district, and at an easy distance as well from the Rhine as from Belgium and France. The fees for students are exceedingly moderate, and the appointed teachers are men of experience, as well as high scientific standing. French is freely spoken among the middle and upper classes of the city alluded to, which is too well known for its beautiful environs to need further comment.

The following original papers are found in this number:—

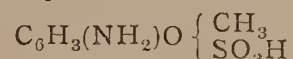
**Thihydrobenzoic and Dithiobenzoic Acid.**—H. Hübner and J. Upmann.—The authors state that their object is to relate the results of their labours on thihydro acids in general, and the substances named at the heading more especially. They first enter into a lengthy discussion, which turns upon the correctness or incorrectness of the labours of Drs. Carius, Vogt, Engelhardt, and others on this subject, and next state, at great length, the preparation of chloro-salicylic acid, with the view of obtaining, from that body, thihydrobenzoic acid; but, since this did not lead to any good result, the thihydrobenzoic acid was prepared by placing dry benzoic acid in the receiver attached to a retort wherein fuming sulphuric acid was heated. The vapours given off converted the benzoic acid into a tough, pasty, brown-coloured fluid, which was first heated by itself, and next treated with carbonate of lead, yielding a salt,  $\text{C}_6\text{H}_4\text{SO}_2\text{O.CO.OPb}$ . This was converted into

a soda-salt, which, in its turn, was acted upon by chloride of phosphorus, yielding  $\text{C}_6\text{H}_4\text{SO}_2\text{Cl.CO.Cl}$ , sulphobenzoic acid-chloride, a fluid insoluble in water. This body, treated with tin and hydrochloric acid, yields, after purifying,  $\text{C}_6\text{H}_4\text{SH.CO.OH}$ , thihydrobenzoic acid, very difficultly soluble in water, and not even readily in alcohol; it is a solid crystalline substance, fusing at from 242°–244°. The authors describe several of the salts of this acid, and also metabromo-thihydrobenzoic acid,  $\text{C}_6\text{H}_3\text{Br.SH.CO.OH}$ , fusing at 256°, insoluble in water, and readily soluble in alcohol.

**Contribution to Our Knowledge of Zirconium.**—Dr. E. Melliss.—The author describes—Bromide of zirconium, a white crystalline powder, readily volatilised by heat, decomposes in contact with water, forming zirconium oxybromide,  $\text{ZrBr}_4 + \text{H}_2\text{O} = 2\text{HBr} + \text{ZrBr}_2\text{O}$ . The oxychloride of zirconium is  $\text{ZrCl}_2\text{O} \cdot 4\frac{1}{2}\text{H}_2\text{O}$ . Zirconium and iodine do not combine together at all. Zirconium and aluminium-silicium,  $\text{Zr}_2\text{Al}_6\text{Si}$ , was obtained by fusing together 1 part of zirconium, 5 parts of cryolite, 1 part of aluminium, and 10 parts of a mixture of the chlorides of sodium and potassium.

**Final Result of the Action of Chlorine Gas upon Chloronaphthalene.**—A. Faust.—The author simply says that the body which has been called  $\beta$  tetrachloro-naphthalene has been found to be enneachloro-dinaphthalene,  $\text{C}_{20}\text{H}_7\text{Cl}_9$ .

**Ortho-Nitrotoluol.**—F. Beilstein and A. Kuhlberg.—The authors describe—The sulpho-acid of ortho-nitrotoluol and several of its salts; next, ortho-amido-toluolsulpho acid—



$\gamma$  dinitrotoluol;  $\gamma$  trinitrotoluol; dinitrotoluol sulpho-acid. The paper winds up with a synoptical tabulated review of para-, ortho-, and meta-nitrotoluol and its derivatives.

**Action of Bromine upon Pyro-Tartaric Acid.**—B. Lagermarck.—This paper is divided into the following sections:—Monobromocitraconic acid-anhydride,  $\text{C}_5\text{H}_3\text{BrO}_3$ , and salts of this acid; tribromopyrotartaric acid,  $\text{C}_5\text{H}_3\text{Br}_3\text{O}_4$ , and salts of this acid.

**Incandescence Phenomenon of Ammonio-Phosphate of Magnesia and Pyro-Phosphate of Magnesia.**—O. Popp.—After discussing, at some length, the value of the assertions made in respect of the cause of this well-known phenomenon, the author states that a series of experiments made by him with perfectly pure materials (because, if the ammonio-phosphate of magnesia is not pure—if even a trace of lime or other salts are present, the phenomenon is either not seen at all, or greatly decreased), has proved to him that the cause is due to a change, or conversion, from the crystalline to the amorphous state; a kind of fusion takes place. The corresponding arsenic combination does not exhibit the incandescence, because it is decomposed, on being heated, in a more complex manner, the result of which is the setting-free of some magnesia. The oxides of iron and chromium, when heated as hydrates, also exhibit incandescence; and the author states that the great difficulty experienced in re-dissolving these oxides after ignition in strong acids, is due to the partial fusion they undergo at the moment the incandescence takes place.

*Bayerisches Industrie und Gewerbe Blatt*, April, 1870.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences.

**Woody Fibre as a Substitute for Paper-Making Materials, and on Völter's Wood-Shaving and Pulping Machine.**—Dr. Landes.

**The Manufacture of Paper in General, and on the Quality of the Paper made Now-a-days as compared with that made at More Remote Periods.**—J. Bullinger.—These two memoirs are, we we regret, too lengthy for any useful abstraction, but contain very valuable hints to paper makers.

**Preparation of Spirits from Lichens.**—Dr. Stahlschmidt.—The large quantities of lichens (marine as well as terrestrial) found in many parts of Europe may be, indeed, usefully applied in this manner, and thus a saving effected in the consumption of grain for the purposes of distilleries. The author describes the process at length; the cellulose of the lichens or moss is converted into glucose by boiling with from 7 to 10 per cent of the weight of the mass of hydrochloric acid (sp. gr. 1.165) by the aid of steam; the acid is saturated with chalk, and the saccharine matter brought to fermentation; 20 lbs. of moss or lichen yield five litres of spirit at 50 per cent anhydrous alcohol.

*The Journal of the Franklin Institute*, April, 1870.

This number contains the following original papers and memoirs relating to physico-chemical and applied sciences:—

**Carbonic Acid Apparatus.**—W. H. W.—The description, illustrated with a woodcut, of an improved apparatus for the estimation of carbonic acid upon the plan of Mohr's well-known contrivance. The use of anhydrous sulphate of copper, jointly with fused chloride of calcium, is recommended as a drier in case hydrochloric acid is used in the analysis.

**Corrosion of Iron Water-Pipes.**—M. Graff.—The pipes alluded to, made of wrought-iron (boiler-plate), 7 feet in diameter, were completely preserved against corrosion by being painted, while hot, with boiled coal-tar; an attempt to protect the pipes by strips of zinc entirely failed. Nothing is said as regards the cause of the corrosion, but the pipes are used to convey water for drinking and domestic purposes.



**Physical Constitution of the Sun.**—B. A. Gould.—A lengthy paper discussing various points of scientific interest in relation to this subject.

**Diffraction Produced by the Edges of the Moon.**—E. C. Pickering.

**Coal and Smoke Consumption.**—J. T. Rich.—The author describes a contrivance whereby the bituminous coal, used as fuel for locomotive engines on the Pennsylvania railroad, is gradually converted, while serving as fuel, into coke, the combustible gases and volatile matter giving off flame, and the result being a very complete combustion free from smoke; but the question whether steam can be made fast enough is not yet decided.

*Journal für Praktische Chemie* (double number), Nos. 8 and 9, 1870.

The greater part of this number is filled with Professor von Liebig's paper—

#### Fermentation and the Source of Muscular Power.

The following original memoirs and papers are also met with in the above-named journal:—

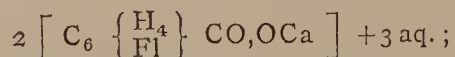
**Fluorbenzoic Acid and Fluorbenzol.**—Dr. R. Schmitt and Dr. H. von Gehren.—The authors describe at great length the preparation of fluorbenzoic acid from diazo-amido benzoic acid, by treating that substance at a high temperature in a platinum basin with hydrofluoric acid; the reaction takes place according to the following formula:—



the fluorbenzoic acid thus obtained resembles, as far as its physical properties are concerned, benzoic acid; it is, however, far more volatile, fuses at 182°, difficultly soluble in cold, readily in hot, water, as also in ether and alcohol; its aqueous solution exhibits a strongly acid reaction to test paper and decomposes inorganic carbonates very readily; the acid does not act upon glass, is a very fixed substance, which may be even dissolved in concentrated sulphuric acid without decomposition; formula— $C_7H_5FIO_2$ ; contains 13.6 per cent of fluorine. The authors describe a series of the salts of this acid; the formula of the silver salt is—



calcium salt—



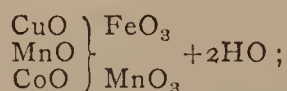
fluorbenzol,  $C_6H_5Fl$ , is a crystalline solid, boiling at about 183°, fusing at 40°, insoluble in water, and specifically heavier than that liquid, readily soluble in ether and alcohol.

**Action of Fluid Phosgen on Some Organic Compounds.**—Dr. Th. Kempf.—This lengthy memoir is divided into the following sections:—Action of fluid phosgen upon phenol; action of fluid phosgen upon cresol; action of fluid phosgen upon thymol; action of fluid phosgen upon benzoyl hydride; action of fluid phosgen upon acetone.

**Formation of Ozone during Active Combustion.**—C. Thau.—The author describes, at length, a series of experiments which prove that during the rapid combustion of substances containing hydrogen, especially gases, a certain though small quantity of ozone is formed; the conditions under which the substance is best obtained during combustion are also fully explained.

**Behaviour of Permanganate of Potassa with Sulphuric Acid.**—Dr. Spiess.—The author states that while he was engaged preparing from a mixture of permanganate of potassa (the dry salt) and concentrated sulphuric acid ozone, he was astonished by the appearance of violet-coloured vapours, which at first he believed to be due to iodine, and consequently an impurity of the salt alluded to; on investigation, however, no iodine was found at all; on repeating the experiment, the author obtained what he thinks is a new, hitherto unknown, compound, but his researches on this point are not quite finished.\*

**On Rabdionite, a New Mineral, and on Asbolan.**—F. von Kobell.—The mineral called rabdionite by the author has a specific gravity of 2.8, is black coloured, while in solid lumps its powder is deep brown; it fuses readily before the blow-pipe, yields, with borax, a blue-coloured bead, is completely dissolved by hydrochloric acid, chlorine being evolved; in 100 parts it consists of peroxide of iron, 45.00; oxide of manganese, 13.01; alumina, 1.4; oxide of copper, 14.0; protoxide of manganese, 7.61; protoxide of cobalt, 5.10; water, 13.5; formula—



the asbolan alluded to by the author is a mineral found near Saalfeld; it contains a small quantity of lithia, but chiefly oxide of manganese, which constitutes 54 per cent of the whole.

**The Theory of Flame.**—K. Knapp.

**The Polybromides of the Tetra-Ammonium Bases.**—P. C. Marquart.—The first instalment of a lengthy memoir on this subject.

\* The editor of this periodical, in a foot note, states that the material alluded to by the author of this paper is permanganic acid contaminated with some sulphuric acid, and also calls attention to the researches on the action of the two substances alluded to, made by Dr. Unverdorben, Dr. Wöhler, and others.

*Les Mondes*, June 16, 1870.

This number contains, under the title to be presently mentioned, a statement which, although strictly of architectural importance only, we mention because it concerns one of the largest, as well as one of the most celebrated, buildings of the world—

**Inclination of the Axis of the Basilica of St. Peter at Rome.**—In a letter to the eminent editor of the above-named periodical, it is stated that M. Crozes, a barrister from Albi (France), while temporarily sojourning at Rome, and minutely inspecting the celebrated Basilica (church), found that the main lines (centres) of the dome and the western main entrance of the building, do not, as it should be, coincide, but are no less than 15 metres mutually out of the plumb-line. (The building was not constructed by one architect—the dome being the work of Michel-Angelo, and the rest that of Carlo-Maderno.) This defect, it appears, has never even been found out, even in modern days; and, on being consulted on the subject, was found to be unknown as well to the Rev. Father Secchi, S.J., as to Chevalier Martinuci, Professor Sarti, Count Vespignani, and other scientific and architectural authorities at Rome, who, however unwilling to believe, cannot deny the fact as ascertained, and as stated above, to have been accidentally discovered by a non-professional, but an unprejudiced observer. The matter, as may be readily imagined, is now to be thoroughly investigated; but the writer of the letter above alluded to states that the main fact, as discovered, remains, as yet, undisputed.

June 23, 1870.

**Osmose.**—Under this heading, the excellent editor of this periodical states that he has received intelligence from the large beet-root sugar manufactory at Arlowetz, Southern Russia, stating that the osmose process has been applied there under peculiarly-favourable conditions, whereby, on the large scale, 25 per cent of sugar has been obtained from the third crystallisation, instead of only 8 per cent as when the usual methods are applied.

**The Arènes of Paris.**—M. de la Folle.—This author addresses, to the editor of *Les Mondes*, a very lengthy letter, from the contents of which it appears that this building is not at all of Roman construction, but is the work of the King Chilperic (Merovingian race), whose contemporary, St. Gregory of Tours, states, in papers of undoubted authenticity, that this king built arènes at Soisson and Paris. The author, moreover, observes that this statement is fully confirmed by the mode of architecture and materials used, as quite distinct from anything of the kind done by the Romans. The age of the building is, therefore, only thirteen, instead of nineteen or twenty centuries.

## NOTES AND QUERIES.

**Ozone.**—Can any of your readers give me the most expeditious and economic way to produce ozone in quantity?

**Atomic Weights.**—If  $Co_26NO_2 + 6(KNO_2) = C_2O_3 = 18.35$ ,  $K_2O = 31.24$ , and  $N_2O_3 = 50.41$  per cent, what are the atomic weights of Co, K, N, and O? An answer will greatly oblige.—A STUDENT AND CONSTANT READER.

**Estimating Sulphide and Sulphite of Calcium.**—Can any of your correspondents kindly inform me of a method of estimating the sulphite and sulphide of lime in black-ash waste after being oxidised by Mond's process?—ALKALI.

**Lead Roofing.**—(Reply to "Slates")—The matter you complain of is not of rare occurrence, and its prevention is not an easy matter, since lead which has even been painted over is gradually acted upon in the manner alluded to. As a remedy, you may try good asphalt-varnish, used as a paint, or thickly-boiled coal-tar, applied on the metal while hot. But the best of all will be to convert the lead superficially into sulphide (black-coloured) of lead, by washing the lead over with a hot and concentrated solution of a soluble alkaline sulphide; for which purpose the substance known under the name of "hepar sulphuris," of the older pharmacopœias, will answer very well. Galena, crystallised sulphide of lead, is not perceptibly acted upon by atmospheric agency; and the amorphous sulphide of lead is insoluble in water, even when containing carbonic acid.

## TO CORRESPONDENTS.

\* \* Vol. XXI. of THE CHEMICAL NEWS, containing a copious index is now ready, price 11s. 4d., by post, 11s. 10d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our office, or, if accompanied by a cloth case, for 1s. Subscribers wishing to complete their sets of volumes are requested to apply to the publisher, who will give them information respecting scarce numbers and volumes. Vol. xxii. commenced on July 1st, and will be complete in twenty-six numbers.

J. Muspratt and Sons.—Received with thanks.

S. Beswick (Paterson, New Jersey).—Many thanks for your communications; they shall be inserted in an early number.

One of your Subscribers.—A description of "The Ozoniseur," is not given in M. Houzeau's memoir.

F. W. Clarke (San Francisco).—Any light tar oil will serve as fuel for Griffin's oil blast lamp; the price would be £2 10s. Our publisher would undertake the forwarding of any apparatus you may require.



# THE CHEMICAL NEWS.

VOL. XXII. No. 555.

## PRELIMINARY NOTE ON A NEWLY-DISCOVERED PROPERTY BELONGING TO RUBIDIUM AND CÆSIUM,

AND ON THEIR OCCURRENCE IN SEA-WATER AND IN  
MARINE PRODUCTS.

By E. SONSTADT.

WHEN chloride of calcium and oxalate of ammonium are added in sufficient quantity to a neutral or alkaline solution containing rubidium and cæsium, the whole of these alkalies falls with the precipitated oxalate of calcium, from which they cannot be washed out. Other alkalies, if present, remain in the solution. Rubidium and cæsium are thrown down in like manner along with carbonate of calcium, but the precipitate is slightly decomposed by prolonged washing with pure water; nevertheless, the filtrate, with a moderate quantity of washings, is spectroscopically free from these alkalies. With sulphate of calcium, the behaviour is similar, but the compound formed is more soluble than from the calcium-salt; and from a large quantity of sulphate of calcium, containing but little of these alkalies, most of the latter may be separated by much washing. Rubidium and cæsium fall, also, with tungstate of calcium, but the compound is almost entirely decomposed by much washing. When a solution of chloride of calcium containing rubidium and cæsium is *partially* precipitated by oxalate of ammonium or carbonate of sodium, a portion of the rare alkalies remains in solution with the remainder of the calcium-salt. A strong solution of chloride of calcium, whether in water or in alcohol, dissolves the chloro-platinates of rubidium and cæsium rather freely, and the latter are not precipitated on dilution. Neither carbonate of magnesium nor alumina carry down with them rubidium and cæsium salts.

*Sea-Water.*—If oxalate of ammonium is added in excess to sea-water, and the well-washed precipitate ignited, moistened with nitric acid, and examined in the spectro-scope, the Rb and Cs  $\alpha$  lines will be distinctly seen in a good flame of dry hydrogen. Whether they would also be visible if examined in the usual gas-flame of a Bunsen's burner, I have no opportunity of trying. One ounce of sea-water gives material enough for several trials in the spectro-scope. When, however, sea-water is evaporated to dryness, and the residue treated with a small quantity of water, filtered, the filtrate evaporated to a very small bulk, and, after addition of nitric acid, examined in the spectro-scope, only the sodium and potassium lines are visible, nor can the rare alkalies be detected in the filtrate by the help of precipitation by platinic chloride.

*Seaweed.*—I became aware of the presence of other than the common alkalies in seaweed more than eighteen months ago. Rubidium and cæsium may be detected by the careful application of ordinary methods, not only in mother liquors, but in "kelp salts," in sulphates and chlorides of potassium, and in the drainage of wet seaweed.

*Shells.*—A few shells from the sea-shore have been examined by igniting chips, moistening with nitric acid, and introducing to the hydrogen-flame before the spectro-scope. All gave the Rb and Cs lines apparently with equal intensity and with one another, and with lime obtained direct from sea-water. Among the shells examined, were those of the oyster and acorn-barnacle.

*Limestone.*—Lime from Castletown, in the Isle of Man, showed in spectro-scope exactly like the shells above-named. About a pound-weight of this lime was put into a funnel, and slowly washed for about ten days; it still

showed the Rb and Cs lines, but the latter very faintly. The filtrate was evaporated to a small bulk, air being blown through until a scum no longer formed. The liquid portion was then rich in potassium salts but did not contain a spectroscopic trace of Rb or of Cs. Every trace of these alkalies that had been washed out of the lime remained with the carbonate of calcium formed during the boiling down. The lime brought to Ramsey, from Castletown, contains many lumps which scarcely "slake" on wetting; such lumps are locally called over-burnt, but a qualitative examination showed that they differed from good lime only in containing a larger proportion of clay. As the clay in ordinary limestone is usually supposed to be the source of the alkalies, it might have been expected that this clayey lime would have been richer in rubidium and in cæsium than the other sort. But the contrary was the case. *Marl*, from near Ramsey, which contained much carbonate of calcium, with clay, shows no line of Rb and Cs when examined in the spectro-scope in the same manner as the other substances mentioned. The average of such Castletown lime as I have examined contains about 5 per cent of clay, equal to about half that proportion in the limestone before burning.

I have made some approximate quantitative determinations of the proportion of rubidium and of cæsium contained in some of the substances mentioned in this note; but, as these results are, as yet, only roughly approximate and incomplete, I reserve them, as well as all theoretical considerations, for another time. But, this much is already clear—these alkalies can no longer be styled rare, since even in a few grammes of sea-water they can be easily recognised.

## GENERAL DOCTRINE OF SOLUTIONS. SWEDENBORG IN 1721-2 AND DALTON IN 1840.

By S. BESWICK.

THE practical scientist will contend that we must reserve the honours of science and discovery for those who reduce conjecture to truth by the evidence of experiment. This rule is well recognised and established, and we accept it as founded in justice and necessity. The first experimental demonstrator of the general doctrine of solutions, and he only, shall have the honours. Practical Science has no religious prejudices, and acknowledges no favourites. If Swedenborg lays down clearly the general doctrine of solutions, and gives definite experimental illustrations of the doctrine, then, we claim, he has fulfilled the conditions, and reduced conjecture to truth by the evidence of experiment and observation; and we expect that critics of the experimental school will give him the honours promised to be reserved for only such as he has proved to be.

The general doctrine of solutions approximates in importance to that of the atomic theory. Dalton appears to have been the first to make this important discovery amongst the chemists of this century. He first observed it about the year 1840, at which time he pronounces it a new discovery. But Swedenborg had published the same doctrine, with abundant illustrations, so far back as 1721-2. His statements are clear, full, and well founded. The following paragraphs are a few which we have taken from his "Principles of Chemistry":—

"When the particles of water contained in the salt are added to the particles of the fresh water, the number of the latter is increased by the number of those in the salt, *that is, they increase the bulk by their own bulk; but it is not so with the saline particles, which only occupy the space in the interstices*, according to the demonstrations in the preceding theories.

"The saline particle in water does not increase the space, but only occupies the void; so that, whatever quantity of salt there may be in the water, the volume is



not in the least increased by the mere particle of salt; but the weight is augmented. Whatever increase of bulk there may be is derived from the particles of water contained in the mass of salt, as will be mentioned hereafter. Hence the saline particle, according to our theoretical delineation, possesses the following qualities:—It can flow easily in water; it fits the convexity of the watery particles; it constitutes one volume with them; it may be separated from them by the slightest touch or motion; it is constantly attended by six aqueous globules, whether it move upwards or downwards; and, by this connection, there is no increase whatever in the volume of the water, but only in the weight.—(P. 31).

"We have now to take into consideration the increase of the solution in bulk and weight. For it is well known that salt water is heavier than fresh; so that the degree of saltiness may be determined by the weight. And this fact, likewise, indicates that the saline particles do not require any separate place for themselves, but that they are contained in the interstices between the particles of water. We have shown that the mere particles of salt cannot at all add to the bulk, but only to the weight, because they occupy the spaces between the aqueous particles."

These theoretical statements are clear and explicit; indeed, it would be difficult to express an idea in more definite and positive terms than those which Swedenborg has used in the above passages. I am not aware that any conjectures of this important fact were ever published until it was actually discovered by Dr. Dalton, in the year 1840, about 119 years after Swedenborg had published it in his "Principles of Chemistry." In the year 1840, Dalton discovered that dry salts have no volume in solution up to the point of saturation. He read an essay to the Manchester Literary Society, October 6th, 1840, on the "Quantity of Acids, Bases, and Water in Salts," from which we cite the following passages:—

"I was greatly surprised at the results. If the salt was anhydrous, it would all go into the bottle, exactly filling it to the grain, showing that the salt enters into the pores of the water.

"The water and solid matter are the same in bulk as the water itself. The solid matter would go into the pores of the water.

"The solid matter only adds to the weight.

"I have tried the carbonates, sulphates, nitrates, muriates or chlorides, phosphates, arseniates, oxalates, citrates, tartrates, acetates, &c.; and have been universally successful. Only the water adds to the bulk, and the solid matter adds to the weight.

"Suppose I take water of 1000 grains' weight, and the sulphate of magnesia and water of 1112 grains' weight: they will be of the same bulk."

And, in a paper read at a subsequent date, to the same society (*Manchester Memoirs*, vol. i., new series), he expressly declares that this fact was new to him, and to the scientific world at that date (1840); the discovery of which almost rivalled that of the atomic theory. He says:—

"This fact was new to me, and, I suppose, to others. It is the greatest discovery that I know of, next to the atomic theory."

In nearly all these passages, the words are italicised by Dalton himself. The principal, if not the only, reason for writing the first essay was to publish to the world what he regarded as a new and important discovery—that acids, bases, and salts do not add to the bulk, but only to the weight, of solutions. The question of priority of publication can be readily seen from the following comparison of dates and statements.

Swedenborg in 1721-2.

"We have shown that the mere particles of salt cannot at all add to the bulk, but only to the weight, because they occupy the spaces between the aqueous particles."—(P. 51).

Dalton in 1840.

"The water and solid matter are the same in bulk as the water itself. The solid matter only adds to the weight. The solid matter would go into the pores of the water."

The same fact is as broadly announced by Swedenborg as by Dalton, and in terms whose identity with those used by Dalton cannot be disputed. Indeed, the fact is more tersely and clearly expressed by Swedenborg than by Dalton.

Drs. Playfair and Joule have pursued similar researches, supplemental, in point of time, to those of Dalton; and have come to conclusions coinciding with results first obtained by the author of the atomic theory. Acids, bases, salts, add nothing to the volume or bulk of solutions, but only to their weight. Other chemists have obtained like results. It was thought that Dalton's experiments and alleged discovery required the verification of additional testimony and experiments before such a remarkable law was acknowledged; and these latter researches were designed to give this verification.

We claim that the Swedish philosopher, Swedenborg, was the first to suggest, verify, publish, and place on record, in a work called "Principles of Chemistry," the date of whose publication is certain, the general doctrine of solutions. The right to a scientific idea or theoretical discovery is secured by the act of publication; and, in virtue of such act, priority of conception and verification of the general doctrine belongs indisputably to Swedenborg.

Paterson, New Jersey, U.S.,  
June 15th, 1870.

ON THE

# POTASSIO-COBALTIC NITRITE KNOWN AS FISCHER'S SALT, AND SOME ANALOGOUS AND RELATED COMPOUNDS.

By SAMUEL P. SADTLER.

(Concluded from p. 17.)

HAVING now made a complete statement of all my analytical results in the case of Fischer's salt proper, as well as in this series of analogous and related compounds, which I have described in this connection, and noticed the conclusions to be drawn from them, before summing up my argument I will examine how the results of Stromeyer, Erdmann, and Braun compare with my own. In the first case, I think the last argument drawn from the similarity of weights of double nitrite and double sulphate in the protoxide-salts, and the difference of weights of double nitrite and double sulphate in the sesquioxide-salts, effectually precludes our assigning a formula like that of Stromeyer (in which  $2(\text{N}_2\text{O}_3)$  combines with  $\text{Co}_2\text{O}_3$ ) to the normal Fischer's salt. The salt Stromeyer analysed was probably a mixture of "acid" and "neutral" salts, as he speaks of adding "a little acetic acid." It is easily seen that a mixture of the "acid salt" and the yellow "neutral salt" would give figures approximating to his. Erdmann's results correspond, in the main, to the analysis of my second preparation. The only difference, then, is that I have introduced a generalisation, which, I think, my figures fully justify. With Braun's results I am hardly able to make a comparison, as he made his preparation in a manner totally different from that followed by either Erdmann or myself. His formulæ, as might be inferred from my statement of them in the beginning of this paper, I am still less able to accept.

To sum up briefly, the reasons for regarding Fischer's salt as a potassio-cobaltic nitrite, having the essential formula  $\text{Co}_26\text{NO}_2 + 6(\text{KNO}) + \text{aq.}$ , are:—

1. The liberation of O at the moment of its formation,



and the rapidity with which, under these circumstances, the salt forms, would seem to justify the assumption.

2. The analyses of six distinct preparations sustain it.
3. The existence of corresponding sodic and ammoniac salts is proved by analysis.
4. The formation of substitution-compounds exactly analogous to well-known salts is proved by analysis.
5. The analogy of Fischer's salt to double cyanides, chlorides, and nitrites proved to contain a similar hexatomic atom.
6. The difference of ratio between the weights in the protoxide and sesquioxide salts is marked and constant throughout.

Accepting these proofs, we will sum up with equal brevity the formulæ of the salts analysed on this view—

Tri-potassio-cobaltic nitrite,	$\text{Co}_2\text{NO}_2 + 6(\text{KNO}_2) + \text{aq.}$
Di-sodio-cobaltic nitrite,	$\text{Co}_2\text{NO}_2 + 4(\text{NaNO}_2) + \text{H}_2\text{O.}$
Tri-sodio-cobaltic nitrite,	$\text{Co}_2\text{NO}_2 + 6(\text{NaNO}_2) + \text{H}_2\text{O.}$
Di-ammonio-cobaltic nitrite,	$\text{Co}_2\text{NO}_2 + 4(\text{NH}_4\text{NO}_2) + 2\text{H}_2\text{O.}$
Tri-ammonio-cobaltic nitrite,	$\text{Co}_2\text{NO}_2 + 6(\text{NH}_4\text{NO}_2) + 2\text{H}_2\text{O.}$
Luteocobaltio-cobaltic nitrite,	$\text{Co}_2\text{NO}_2 + \text{Co}_2\text{I}_2\text{NH}_3, 6\text{NO}_2 + \text{H}_2\text{O.}$
Roseocobaltio-cobaltic nitrite,	$\text{Co}_2\text{NO}_2 + \text{Co}_2\text{I}_2\text{NH}_3, 6\text{NO}_2 + \text{H}_2\text{O.}$
Xanthocobaltio-cobaltic nitrite,	$\text{Co}_2\text{NO}_2 + \text{Co}_2\text{I}_2\text{NH}_3, 6\text{NO}_2 + \text{H}_2\text{O.}$
Potassio-dicobaltous nitrite,	$2(\text{Co}_2\text{NO}_2) + 2(\text{KNO}_2) + \text{H}_2\text{O.}$
Potassio-monocobaltous nitrite,	$\text{Co}_2\text{NO}_2 + 2(\text{KNO}_2) + \text{H}_2\text{O.}$

These, it will be seen, are capable of ready conversion into atomic formulæ, thus:— $\text{Co}_2^{\text{vi}}[\text{K}(\text{NO}_2)_2]_6$  and  $\text{Co}_2^{\text{vi}}[(\text{Na}(\text{NO}_2)_2)_2(\text{NO}_2)_4]$ , and so on.

In the course of my examination of these salts, I had an opportunity of comparing the relative merits of the different analytical methods employed. A brief statement in regard to them may be of some value.

1. Determination of Co and K. The double sulphate method, already alluded to, was first proposed by Gibbs and Genth;\* and I find it to give extremely close results. Sulphuric acid is added to the weighed portion of the salt, in a porcelain crucible, which is then heated carefully, either by a ring gas-burner from above or by radiation while supported in a sheet-iron crucible. After the nitrous acid is all driven off, with most of the excess of sulphuric acid, the sulphates begin to fuse, and as the last trace of sulphuric acid goes off they pass into calm fusion; they will then bear a very considerable increase of heat without farther decomposition. I found this method capable of extension to both the soda-salts, as well as to the protoxide-salts, the double sulphates formed having, of course, a constitution depending upon the proportion of the bases in the original salts. The soda-sulphates did not appear, however, to possess as perfect a fusibility as the double potash-sulphate from Fischer's salt; while the double sulphates from the protoxide potash-salts were also less fusible, in proportion to their greater ratio of Co. I give an instance in proof of the accuracy of this method. Four determinations of  $\text{CoO} + \text{K}_2\text{O}$  were made in Preparation No. 6 of Fischer's salt, in the manner described. The percentages of double oxides were—48.71, 48.69, 48.66, 48.71. This method was tried by Gauhe,\* without obtaining good results. Several points are to be noticed, however. The salt in which Gauhe sought to verify the composition of the double sulphate was plainly a mixture of "acid" and "neutral" salt. He says, "After some days, small amounts deposited." This was before Erdmann's paper had appeared. Again, Gauhe will find that Gibbs and Genth never even mentioned the use of  $(\text{NH}_4)_2\text{CO}_3$  in this connection; so that his experiments were plainly made under different conditions from those proposed.

2. Determination of Co. I prefer to determine Co as neutral  $\text{CoSO}_4$ . We have the advantage here of determining the Co in the form of a compound of higher atomic weight, thus lessening our errors of analysis. The cobalt is precipitated from the solution of the double sulphates as  $\text{CoS}$ , washed with hot sulphide of ammonium water, dried and roasted, and then converted into sulphate with the aid of aqua regia and sulphuric acid. The

results are good, although not so exact as in the case of the fusible double sulphates. I also determined Co as metal, by H, after its precipitation as hydrated oxide by Cl and acetate of soda—a method proposed by Popp.\* Instead of Cl, I found it far more convenient in practice to use a strong solution of  $\text{Cl}_2\text{O}_4$ , which is a powerful oxidising agent, and, as it can be kept, becomes a useful laboratory reagent. This method, however, does not always give good results, on account of the difficulty of washing the hydrated  $\text{Co}_2\text{O}_3$  till free from alkali.

3. Determination of the N. This was done first by the modification of Bunsen's† method proposed by Dr. W. Gibbs,‡ which space will not permit me to give in detail; the reader is therefore referred to the original paper. Suffice it to say that, for nitrates and nitrites to which it is applicable, it is an excellent method. The loss of the combustion-tube can be nothing but N and  $\text{H}_2\text{O}$ . If, therefore, the  $\text{CaCl}_2$  tube retains the  $\text{H}_2\text{O}$  accurately, the remainder is N. Whether, therefore, the  $\text{H}_2\text{O}$  is accurate or high from hygroscopic moisture, the nitrogen must be accurate, being subject to no source of error.

The nitrogen was also determined by volume, using the Sprengel pump. This method was first proposed by Frankland|| for nitrogen in analyses of potable waters, but he did not apply it then to organic analysis. The application, however, had been made in this laboratory, by Dr. Gibbs, some months before Dr. Frankland's paper was received. A vacuum is first made in the combustion-tube, by means of the mercury-pump; the delivery-tube from the pump is then connected with a Simpson's receiver, and the vacuum destroyed by heating some  $\text{CO}_2$  placed in the anterior portion of the tube. Any excess of  $\text{CO}_2$  is absorbed by the KHO solution in the receiver. The combustion is now made. A final vacuum is then obtained by the pump, and the receiver disconnected. After a short time, the gas is transferred to a eudiometer-tube, and measured according to the methods of gas analysis. The results are generally good, but depend upon the vacuum obtained at the beginning and end, on the perfect combustion, and on the perfect transfer of the gas.

In conclusion, I would present my grateful acknowledgments to Dr. W. Gibbs, to whose kindness I am indebted for the selection of my subject, for the use of materials, and for many valuable suggestions during the prosecution of my work.—*Am. Jour. Sci.*, lxix., 189.

## AIR-POLLUTION BY CHEMICAL WORKS.

A MANUFACTURER, having realised his primary object of making what he can out of the materials which pass under his hands, and having utilised all that he deems valuable in them, finds there is yet another need to be fulfilled;—he must get rid of his refuse, and that as speedily as possible. Our present object is to watch this latter operation, and, losing sight of the beautiful or useful results of his work, to direct our attention to what is waste or refuse, and enquire how he disposes of it. When this is solid and bulky, it must be removed at the cost of much labour, and a place must be provided where it can be deposited. When the refuse is a liquid, the process of getting rid of it is generally less expensive; it will flow away in the water-courses, if only proper drains and passages are provided. When the refuse is gaseous, this process of removal is easier still: no passages need be cut, no culverts nor bridges built; the vapour can be allowed to pass into the air, and is blown away.

In each of these cases the manufacturer's object is attained; he is rid of the refuse, and has room for renewed work. Unfortunately, however, although he is rid

\* "Researches on Ammonia-Cobalt Bases," p. 49.  
† *Zeitsch. Anal. Ch.*, iv., 56.

\* *Ann. Ch. u. Ph.*, 131, 363.

† *Ann. Ch. u. Ph.*, 72, 40.

‡ *Am. Journ. Sci.*, xxxvii., 350.

|| *Qu. Journ. Chem. Soc.*, 1868, p. 90.



of it, his neighbours are not so; they find, on the one hand, that the water of their brook is no longer fit for use nor pleasant to look at, and the air they breathe is polluted with unsavoury and noxious vapours. Where a manufactory of this kind stands alone, or where only those who are dependent on it for their subsistence dwell in its vicinity, this state of things goes on for a long time without calling forth much complaint. Sooner or later, however, complaints must come; we cannot all live at arm's length. Population increases, we are pressed together; and, valuable though the various products of manufacturing industry may be, pure air and pure water are more valuable still. Yet we cannot do without the manufactory, unless we return to barbarism. A naked savage, eating uncooked roots, erects no chimney to pour its black or acrid vapour into the air; he discharges the liquor from no dye beck into the clear brook of the glen—but he remains a savage. We must keep our manufactories: by their products we are warmly clothed, our houses are firmly built and are decorated with colours; the wind is shut out by panes of transparent glass; the paper on which we write is white and fair. These and a thousand other things are the results of many a mechanical or intricate chemical process, the waste products from which—solid, liquid, and gaseous—are unpleasant enough.

If, then, we will not go back to barbarism to get rid of our smoke and our dirty water, can we go forward, and, by greater skill, diminish or suppress them? The answer *must be*, "Yes." Yet those only who have to work out the problem know with what difficulty this answer has, in many cases, been given; whilst in many it is not given yet.

The materials which the manufacturer throws away we have already classed, in correct school-room fashion, as solid, liquid, and gaseous. With the first of these the manufacturer alone is concerned, and it may be safely left in his charge. The more of it he produces, the more must he expend in its removal, the more land must he purchase on which to deposit it; and, if he throws away that which is valuable, he is the chief loser. We may therefore safely leave him, with certain reservations, to look after his solid refuse, knowing that no sharper impulse can be applied to induce him to diminish its amount, or to save what is valuable in it, than the spur of self-interest which already exists. We say it may be safely left in his charge; but, if, through some process of fermentation or change, a portion of it shall slip out of his custody, and yield, after rain, a noxious liquid to drain into the nearest brook, or a gaseous escape to contaminate the air around, it falls back into the two other classes.

For the present, we propose to direct attention to the latter of these two classes only—the gaseous. In doing so, we would first dwell on the magnitude of the evil which may and does arise from the pollution of the atmosphere by gases discharged during the carrying on of various manufacturing processes; secondly, on the state of our laws on the subject; and, thirdly, as to the direction which further legislation on the subject should take.

The evils complained of are not uniformly spread throughout the country, and do not come under the observation of anyone. Some districts are found to be specially suitable for carrying on a particular manufacture; so, throughout the country, we find works of a certain kind grouped together. Those who reside in the districts known as "manufacturing" are too familiar with the evils arising from noxious vapours floating in the air to need any setting forth of their extent, unless, indeed, familiarity with these evils has dimmed the perception of their magnitude. In Staffordshire, the so-called "black" country is a district of many miles in extent, blasted by the smoke of the iron-furnaces; in it not a tree can be found, and scarce a blade of grass. Near St. Helens and Widnes, in Lancashire, scarce a living tree is seen in the direction towards which the prevailing winds blow. And, in the valley of Swansea, thickly set with copper-works, not only are the hill-sides bared of the green forests which

once waved there, but the underwood, the shrubs, the hedge-rows, the grass itself, is gone; and, to complete the desolation, when the roots and fibres which permeated the soil died and rotted, the soil itself, no longer able to withstand the action of the rain, was also washed away, leaving only bare heaps of stone and gravel. These (more like huge railway-embankments than natural hill-sides) suffer yet another injury; for the rain, not now absorbed and held back by tree, shrub, grass, roots, or soil, falls on the bare hill-side, as on the slated roof of a house, and as quickly runs off it, ploughing the ground in its headlong course, making each rippling streamlet into a torrent, even during a moderate shower. And still the desolation is not fully described; for, when the even adjustment of nature is disturbed, who shall say where the derangement will stop? Here the grass, the soil, is gone, and with these the insects and birds, with the exception of a few sparrows.

The manufacturing processes which may give rise to noxious vapours are numerous. The French, in the elaboration of their sanitary code, enumerate seventy-four.

These noxious vapours may do injury of two kinds—injury to animal life and to vegetation.

Injury of the former class, though real and widespread, is a matter less easily brought to the measure of money than that of the second class. People are annoyed at a vile smell arising from some manufacturing process, and, by its continuance, are affected in health; but they do not assess the damage in money, and sue for it at law, except in so far as property is injured. Where, however, in an already populous district a factory is established, the emanations from which can be proved to be injurious to human health, there is power for suppressing the nuisance; for, under the Sanitary Act (18 and 19 Vict., c. 121), the "Local authority, when moved by its medical officer of health, or by two legally-qualified practitioners, or by ten householders residing in the district in which the nuisance exists, is bound to complain to the magistrates (two lay, or one stipendiary), and to prosecute the offenders. The penalty, if the case is proved, is a fine of from 40s. to £5 for the first conviction, £10 for the second, and for each subsequent conviction a sum double the amount of the penalty imposed on the last preceding conviction, but so that such cumulative penalty do not in any case exceed £200."

The operation of the law here is clear, and generally satisfactory. This clearness, however, ceases when we turn to the working of the law in cases of injury done to vegetation. The question is not now whether any damage is done to the farmer's crops and trees, but *how much*; for, if an important manufactory is carried on, giving employment to a large number of workmen, producing articles of general value, and returning a handsome income to the proprietor, it would not be wise to put a stop to all this producing power because it of necessity entails a small amount of collateral damage. Rather let those who carry on this lucrative manufacturing business compensate those who are injured by it, and consider that they have only fairly earned that amount which remains when, from their gross profits, they have deducted this charge. In this way we have a gauge by which to determine the amount of forbearance which the public shall exercise towards a manufactory doing obvious damage to the vegetation around it.

If a factory produces a revenue of £1000 to its proprietors, and at the same time injures neighbouring vegetation to the extent of £100, it clearly does more good than harm: the farmer is compensated, and £900 is honestly earned after everyone is satisfied. Put, however, the figures the other way. Suppose the works, while earning £100, to do £1000 worth of damage, and the proprietors compelled to pay this; it will require no injunction from the Court of Chancery to make them close the works, or else to improve the manufacturing process so as materially to lessen the damage done.



But we have hitherto considered only the relations of the manufacturer and the farmer, imagining the smoking chimney to be surrounded by corn or clover, orchards and hedge-rows. All these have a known market value, and can be paid for with money. In place of the farmer with his marketable crops, imagine him or his landlord dwelling in the old house of his fathers: the trees which surround his cottage or his mansion are of ancient growth; the place is his home. What money shall compensate for its loss? He may be rich, and put little value on pecuniary compensation. He will feel himself grievously wronged when, his trees being killed, he is offered money in place of them.

This might be said, however, in all cases where the sanctity of private property is invaded. When a railroad is planned, which is to carry a nation's traffic, it will disturb many an ancient hall and many a cottage home. The money equivalent is paid the owner; but, in his eyes, this is often no sufficient compensation. He must, however, bow to his fate, and give way before the greater good of the many. So in the case where a man sees every year the noble trees vanish from his land,—from the ancient domain that has been held in quiet enjoyment by his family through many generations,—and feels himself driven from it by the advancing tide of manufacturers. He is much to be pitied; for, let him be paid ever so liberally for the damage actually done to the estate, he is not compensated. Yet he must submit, and suffer personal loss for the public benefit.

Fortunately, however, these cases are exceptional; generally those interested in the land can be fully compensated in money for all they lose. A farmer who should get £100 for the produce of his wheat-field is content if it brings him in only £50 in the market, provided he can get the remaining £50 by way of damages from the neighbouring chemical manufactory. A question here at once arises. Will he have much difficulty in obtaining from the manufactory the £50, the proved amount of his loss? If the manufactory is standing by itself, he probably will have no great difficulty. If the demand is resisted, his course at law is plain. He proves that, on a certain day, or on many days, the smoke of the offending chimney was seen to fall upon his land; that soon afterwards the crops were visibly injured, in such a way as is known to be caused by chemical smoke. He also further proves, by the assistance of agricultural valuers, that the amount of the damage done is an equivalent of the sum of money he now claims. This chain of evidence is usually so conclusive that the farmer wins the day.

Suppose, however, that, in place of one chemical work being near the farm, there are several in a group, from all of which the smoke approaches simultaneously. These works may be of different kinds: there may be alkali-works and copper-smelting works, glass works and potteries, with chemical works; whose various processes and products defy enumeration. How shall the farmer discriminate? or, rather, how shall he criminate? How shall he fix on the culprit among such a motley crowd of evil-doers? Let us suppose him calling on the first in order, and making his complaint against him, as the one he thinks most likely to have been the offender. The manufacturer explains to him, in the clearest manner, that, from the nature of the processes he carries on and the care with which all injurious vapours are avoided or condensed, he cannot have injured the land. Perhaps it was his friend of the neighbouring works, whose processes are different from his own. Doubtless this gentleman would be equally clear and conclusive in his explanations, and would pass our farmer on once more, to be sent, in turn, from one to the other, but to get redress from none.

The farmer soon learns that the only way in which he can obtain compensation from any of the chemical manufacturers is to fix on one of the works (perhaps the one nearest his land, or the one with the highest chimney), and to watch till he thinks he can distinguish the smoke from it come upon his farm. On that he fixes; and,

shutting his eyes to the other works, and forgetting the injury they probably do him, charges the proprietor with the whole of the damage he has sustained. The judges and juries before whom such cases come for trial are in great difficulty. They know that the manufacturer in question has not done all the damage alleged; yet they have no power of apportioning it between him and other offenders. Therefore, as some of the damage has been proved to come from the defendant's works, they give a verdict for the plaintiff.—*Quarterly Journal of Science*.

(To be continued.)

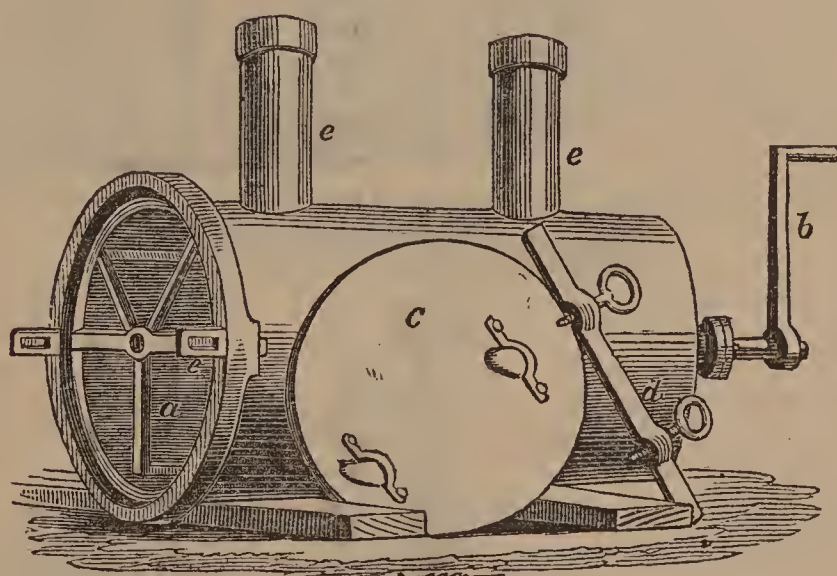
## ON THE ANILINE OR COAL-TAR COLOURS.\*

By W. H. PERKIN, F.R.S.

(Continued from p. 19).

THE first apparatus used in the manufacture of nitrobenzol, for the preparation of aniline for the mauve dye, is shown in Fig. 1. It consisted of a large cast-iron cylinder, *a*, fitted with a stirrer, *b*, and closed with a door, *c*, fastened by a cross-bar and screw, *d*. This cylinder was capable of holding between thirty and forty gallons. It was provided with two necks, *e e*, one for the introduction of the benzol and sulphuric acid, which were supplied through a syphon tube; the other for the exit of nitrous

FIG. 1.



fumes. This last was connected with an earthenware worm, to condense any benzol which might be volatilised by the heat of the reaction. The nitrate of sodium was always introduced into the cylinder before the door was fastened up and luted. Until the preparation of nitrobenzol was understood, there was a great amount of uncertainty in its manufacture, and several explosions occurred, but fortunately without causing any injury to the workmen attending the apparatus. These explosions originated generally from the liberation of too much nitric acid from the nitrate of sodium, by the sulphuric acid, before the formation of nitrobenzol had begun, so that when it started, the chemical action set in with such energy that an explosion ensued. After a few of these unpleasant occurrences, however, sufficient experience was obtained to get the manufacture under control. Apparatus of a much more extensive character has since been substituted for the cylinders. In Figs. 2 and 3 you get a view of the apparatus now used in England for the manufacture of nitrobenzol.

This apparatus consists of large cast-iron pots, *a a a*, about 4 feet 6 inches deep, and 4 feet 6 inches wide; they are arranged in rows, and provided with stirrers, worked from a shafting by means of bevel wheels. This arrangement will be seen from the section, fig. 3; the covers of these vessels are also made of cast-iron, and are in two pieces, *b b'* (Fig. 3), of unequal size, provided with a tall

\* The Cantor lectures, delivered before the Society of Arts.



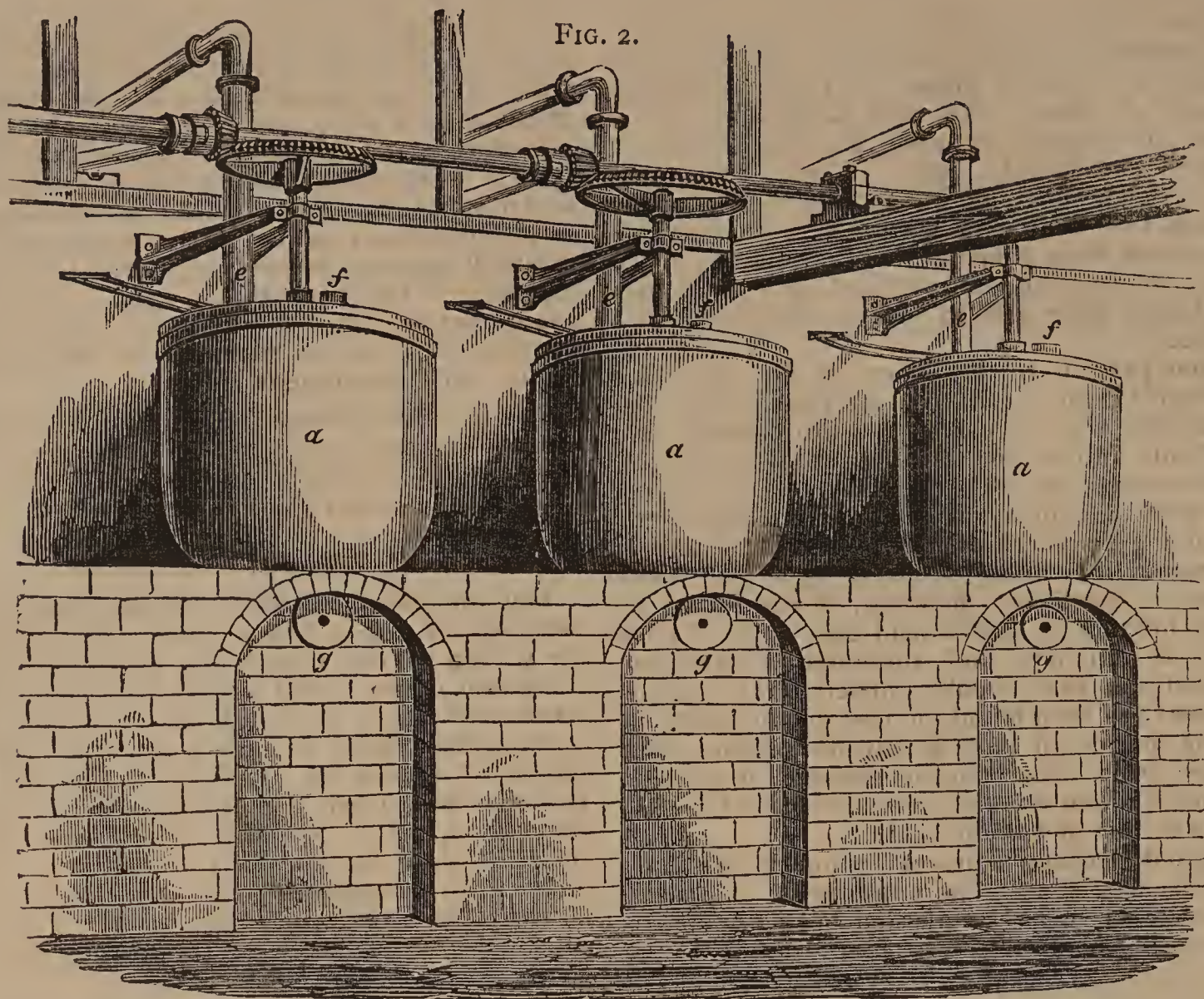


FIG. 2.

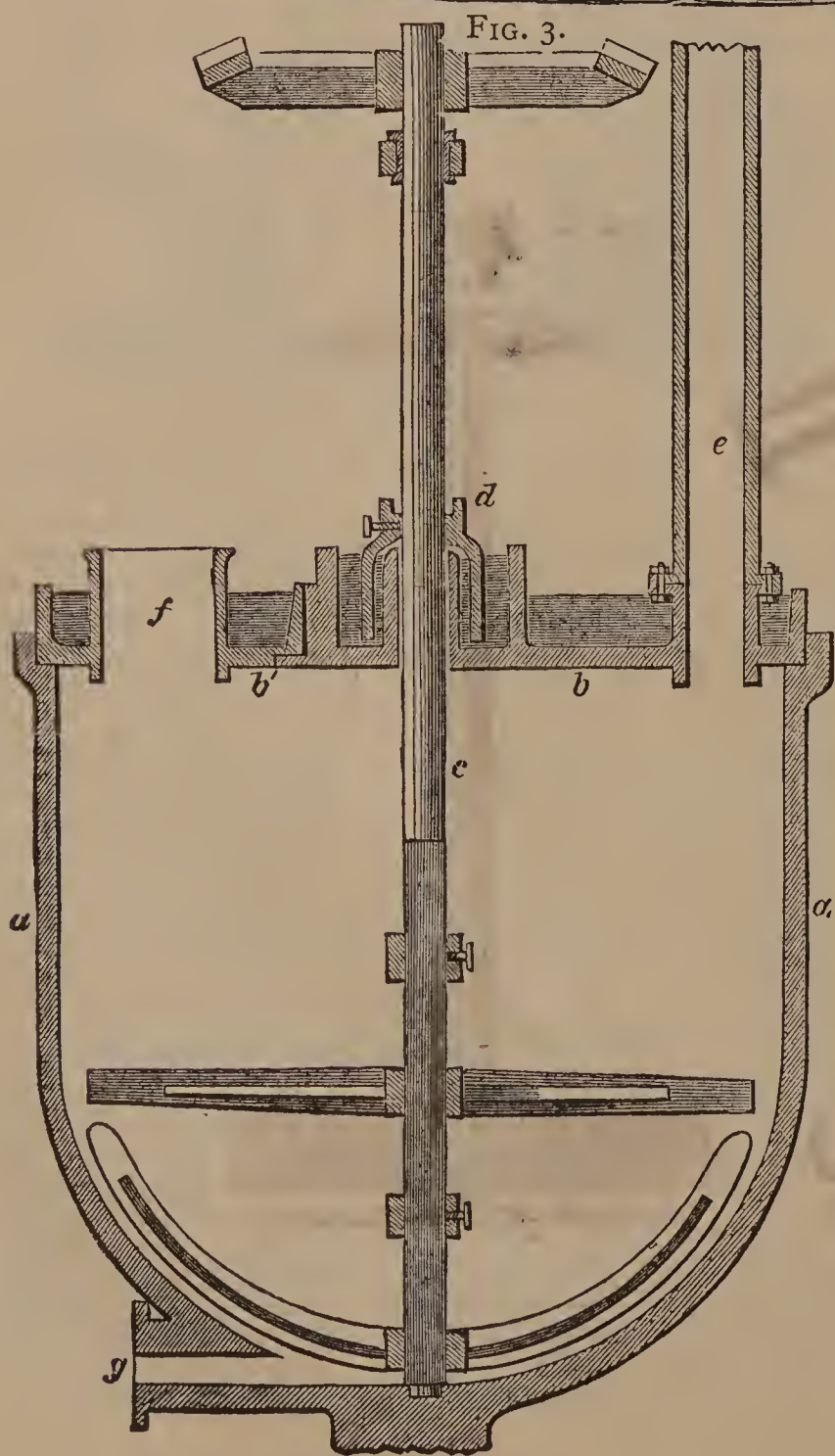


FIG. 3.

rim, and so arranged that cold water may be kept circulating over their surface; this assists in condensing the benzol, which would otherwise distil away by the heat of the reaction. Through the larger half of the cover the spindle of the stirrer, *c*, passes, and on account of the difficulty of keeping a stuffing-box in order when using the powerful chemicals necessary in this manufacture, a kind of water-joint has been substituted. It is necessary that it should be deep and rather capacious, as seen at *d*. Instead of filling this joint with water, which would absorb the nitrous fumes, and produce an acid solution, which would soon destroy the apparatus, the joint is filled with nitrobenzol; a cast-iron tube, *e*, passes through the lid to carry nitrous fumes; this is also cooled, so as to condense any benzol vapour which may have escaped the cooling action of the lid; small pipes are introduced through another opening for the purpose of supplying the necessary chemicals. Besides these there is a large opening, *f*, in the smaller half of the lid, for the purpose of introducing any of the products, which may be added in large quantities at a time. At the bottom of these large vessels are openings for running out the finished product.

The process of preparing nitrobenzol with a mixture of sulphuric acid and nitrate of sodium in place of nitric acid, may be carried on very well in this apparatus, provided sufficient sulphuric acid be employed to produce an acid sulphate of sodium, as this will be found quite fluid at the close of the operation, and can be freely run out at the small outlet. A mixture of strong nitric acid and sulphuric acid is now usually employed for the conversion of benzol into nitrobenzol. In working by this latter method the entire charge of benzol is first introduced through the large opening in the lid; this is then closed and the stirrer set moving; the nitric and sulphuric acids are then cautiously run in through the small pipes, care being taken not to add too much nitric acid, until the red fumes begin to appear. After all the charge of acids has been added, and the reaction has perfectly ceased, the product is drawn off. At first a mixture of sulphuric and nitric acids runs out, and then the nitrobenzol; this is collected separately and purified,



first by agitation with water, and then rendered perfectly neutral by means of a dilute solution of soda. Should it contain any unconverted benzol, this may be distilled off by means of steam. On the Continent, manufacturers do not appear to have succeeded well in manufacturing nitrobenzol; when it first became a commercial article, their difficulty appears to have arisen from the fact that they experimented in earthenware vessels, which are both dangerous and unsuitable, and it was not until information was obtained from England, I believe, that they were able to produce this body at a moderate price.

We will now pass on to the processes for converting nitrobenzol into aniline. I have already mentioned that Zinin was the first who discovered that nitrobenzol could be converted into aniline, or, as he termed it, benzidam. His process consisted in treating an alcoholic solution of nitrobenzol with ammonia and sulphuretted hydrogen; but, although the discovery of this process was one of great importance from many points of view, still it was very tedious. Bechamp, however, found that by employing a mixture of acetic acid and finely divided iron instead of ammonia and sulphuretted hydrogen, the nitrobenzol was very rapidly converted into aniline, and this process has been found the best yet proposed for manufacturing aniline in large quantities. Many other reagents have been suggested, as arsenite of sodium, powdered zinc, &c., but none of them have been found so advantageous as iron and acetic acid.

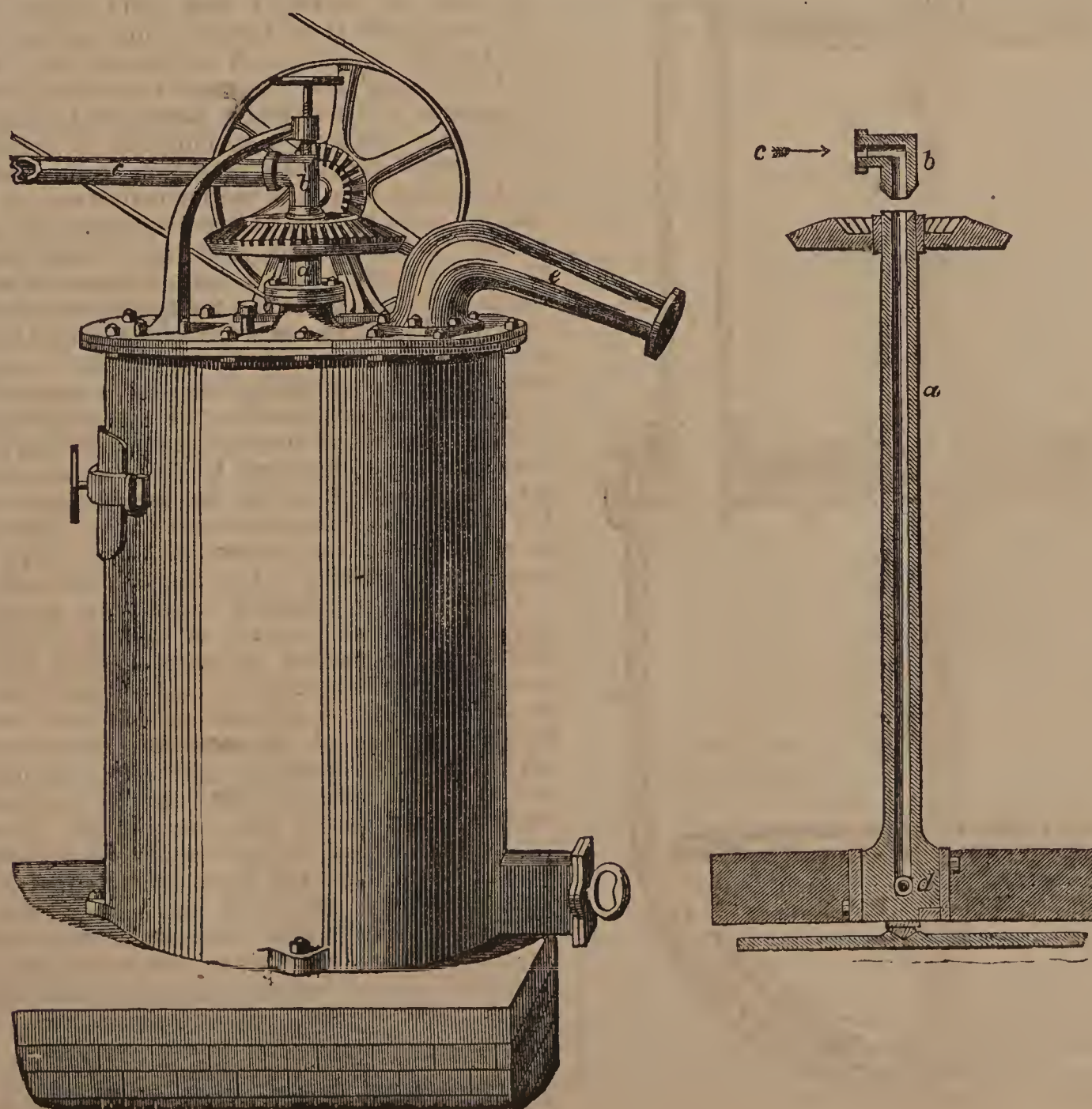
In carrying out Bechamp's process, cylinders like those used for nitrobenzol (Fig. 1) were originally employed. The cylinder was set in brickwork, and heated by means of a small furnace, iron borings were first introduced, and

the door fixed in its place air-tight. One neck was connected to the upper extremity of a cast-iron worm by means of a pipe called an adapter; the second neck being fitted with a syphon-tube, for the introduction of the nitrobenzol and acetic acid. In working on the large scale it is necessary to add the nitrobenzol and acetic acid in small quantities at a time, otherwise the reaction is so violent as to almost burst the apparatus: by working carefully, however, there is no need to fear any difficulties, especially if the stirrer is well used. By the time all the charge has been introduced, a quantity of fluid will have distilled over; this is returned into the cylinder and the fire lit, and the aniline distilled off.

The principal change which has taken place in this process consists in using high pressure or superheated steam for the distillation instead of fire, and working the apparatus by means of a steam-engine instead of by hand. In Fig. 4 is shown a sketch of the apparatus now generally employed for the preparation of aniline.

You will observe that the stirrer, which is worked by bevel wheels, has a hollow shaft or spindle, *a*, as seen in the section. This is ground to an elbow, *b*, connected to the steam main, *c*, and held down by a screw, so that when the steam is turned on, it passes through the hollow elbow down the shaft, and then blows out at the bottom, *d*, among the products; and in this manner the aniline is volatilised, and passes with the steam through the neck, *e*, and is condensed by a worm, not shown in this drawing. Aniline thus obtained is generally re-distilled, and sometimes with a little lime or caustic soda, for the purpose of decomposing a body called acetanilide, which is often produced in the manufacture of aniline,

FIG. 4.





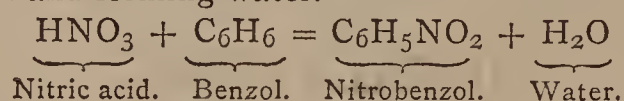
especially if the operation is conducted over a fire instead of with steam.

Commercial aniline generally appears of a pale sherry colour; when chemically pure, it is colourless, but if kept long it becomes quite brown. It possesses a peculiar odour, which is slightly vinous when the aniline is pure. It burns with a smoky flame, but is not very inflammable; its boiling-point is  $182^{\circ}$  C. One of its most characteristic reactions is its power of producing a blue or blue-violet colouration with chloride of lime, to which I shall again have occasion to refer. Aniline differs entirely from benzol and nitrobenzol, being perfectly soluble in dilute acids. This is owing to its being an organic base, and forming compounds with acids. Thus, with hydrochloric acid, it forms hydrochlorate of aniline; with sulphuric acid, sulphate of aniline, &c.

We will now, in a very rapid and general way, glance at the chemical changes which take place in connecting benzol with nitrobenzol and aniline.

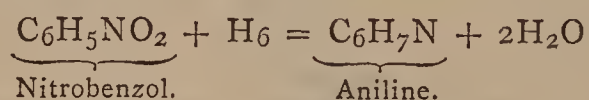
Benzol, as I have already stated, is a hydrocarbon, *i.e.*, a body composed of hydrogen and carbon only; it is represented by  $C_6H_6$ . This is treated with nitric acid, which contains  $HNO_3$ .

The nitric acts upon the benzol and introduces its nitrogen and part of its oxygen, at the same time removing hydrogen and forming water.



Nitrobenzol, when treated with iron and acetic acid, is converted into aniline by the influence of hydrogen gas, in what is termed the nascent state, or the peculiar condition in which it is when being liberated from a compound.

This hydrogen unites with the oxygen of nitrobenzol and removes it as water, and at the same time two atoms of hydrogen combine with the deoxygenated nitrobenzol, forming aniline.



Having now seen the various operations which require to be performed for the production of aniline from coal-tar, we are prepared for the consideration of its coloured derivatives. We will, therefore, commence at once with the first of the coal-tar colours, "the mauve dye." I have already given you the history of its discovery; I will now tell you how it is made.

First of all aniline and sulphuric acid, in the proper proportions for the formation of sulphate of aniline, are mixed in a large vat with water, and boiled until perfectly dissolved. Bichromate of potassium is then dissolved in a second large vat. These two solutions, when cold, are mixed in a third and still larger vessel, and allowed to stand one or two days. In this way a large quantity of a fine black precipitate is formed; this is collected upon shallow filters, well washed with water, and then dried. When dry it is a most unpromising sooty-black powder, and contains various products besides the mauve; the most troublesome of these is a brown, resinous product, soluble in most of the solvents of the colouring matter itself.

At first this resinous substance was removed by digestion with coal-tar naphtha previously to the extraction of the colouring matter, which was afterwards effected with methylated spirits of wine, and the solution thus obtained when distilled left the mauve as a fusible bronze-coloured mass.

When digesting the black precipitate with naphtha or strong spirits of wine, the operation had to be performed in closed vessels under pressure or in connection with a condensing arrangement, otherwise large quantities of these valuable solvents would have been lost; and great difficulty was experienced in getting apparatus perfectly tight, on account of the "searching" character of these fluids. Substitutes had also to be found for the ordinary

materials employed by engineers for making good manhole joints, and a number of other matters which are apparently of but small importance, but it is remarkable the amount of difficulty and annoyance they caused. The method of extraction has, however, been materially improved upon by substituting dilute methylated spirits of wine for strong, as this weaker spirit dissolves only a small quantity of resinous matter but all the colouring matter, so that the digestion with coal-tar naphtha is now found unnecessary.

The solution of the colouring matter in dilute spirit is placed in a still and the spirit distilled off, the colouring matter remaining behind in aqueous solution; this is filtered and then precipitated with caustic soda. It is afterwards collected on a filter, washed with water, and drained until of a thick pasty consistence, and, if necessary, dried.

The solid mauve dissolves very freely in spirits of wine, forming an intensely coloured solution; it is also soluble to a small extent in water, but the aqueous solution on cooling forms a kind of jelly.

The formation of the mauve or aniline purple by the action of bichromate of potassium upon sulphate of aniline is a process of oxidation, and since the publication of the original specification at the Patent Office a great number of patents have been taken out for the preparation of this colouring matter, in which the bichromate has been replaced by other oxidising agents, as peroxide of lead, permanganate of potassium, peroxide of manganese, chloride of lime, ferrocyanide of potassium, chloride of copper, &c.; but I need not make any special remarks upon these various processes, as experience has shown that bichromate of potassium and a salt of aniline, the reagents first proposed, possess advantages over all others, and are now nearly universally employed for the preparation of aniline purple. The next best process appears to be that of Dale and Caro, in which chloride of copper is employed.

The affinity of aniline purple for silk or wool is very remarkable; and, if I take some wool, and pass it through a solution of mauve, you will see how rapidly it absorbs it, even from a very dilute solution. Aniline purple is sent into the market in three different conditions—in paste, in solution, and in crystals; but the latter are very rarely employed, as they are very expensive, and do not offer corresponding advantages to the consumer.

The mauve is the most permanent coal-tar purple known, especially with respect to its power of resisting the action of light.

I will now endeavour to give you some idea of the approximate amount of the various products we have considered obtainable from 100 lbs. of coal; and, for this purpose, I have arranged them in the following table, with their respective weights:—

	Lbs.	Ozs.
Coal.. .. .	100	0
Coal-tar .. .. .	10	12
Coal-tar naphtha .. .. .	0	$8\frac{1}{2}$
Benzol .. .. .	0	$2\frac{3}{4}$
Nitrobenzol .. .. .	0	$4\frac{1}{4}$
Aniline .. .. .	0	$2\frac{1}{4}$
Mauve .. .. .	0	$0\frac{1}{4}$

You see the smallness of the amount of colouring-matter obtainable from coal or coal-tar; but there is fortunately one thing which to some extent compensates for this, and that is the wonderful intensity of this colouring-matter. I will illustrate this remarkable fact. I have here a large carboy, containing 9 gallons of water, and will now add to this a solution containing 1 grain of mauve, and illuminate the liquid with the magnesium-lamp; and you see the single grain has coloured this large bulk of water. A gallon of water contains 70,000 grains; therefore 9 gallons contain 630,000 grains. This solution, then, contains only 1 part of mauve to 630,000 of water.

I have now shown you the manifold operations which have to be performed before we can derive the mauve



from coal-tar, and have also mentioned a few of the obstacles which had to be overcome before its manufacture on the large scale could be accomplished. We have thus laid the ground-work of our subject; and, in our next lecture, I hope to tell you a little more about mauve, and then give an account of the many other colouring-matters of which it may be considered the parent.

(To be continued.)

## NOTICES OF BOOKS.

*Report on the Quality of the Kerosene Oil sold in the Metropolitan District* (New York). By C. F. CHANDLER, Ph.D., &c., New York: D. Appleton and Co. 1870.

THIS paper is a report made by the author in his capacity of Chemist to the New York Board of Health, by which he was instructed to investigate the quality of the Kerosene sold in the city and neighbourhood of New York. The author treats of the composition and varieties of petroleum, on the refining of that liquid, on the quality of kerosene oil, and on the processes vaunted for rendering benzine non-explosive, all of which are perfectly worthless; and, next, enters into the details of the investigation of seventy-eight samples of kerosene oil obtained from the same number of retail dealers. Not one of these samples is safe; all samples contained benzine, gasoline, and naphtha to more or less extent; and only one sample (No. 79), also obtained from a retail dealer, was free from these admixtures, and contained only pure burning oil, usually known in this country as paraffin or crystal oil. The reporter next relates a series of experiments made with the view of ascertaining to what temperature the burning oils become heated in the reservoirs of the lamps in which they are used, different kinds of lamps being employed for this purpose. From these experiments we learn that, even while burning for seven hours, the temperature of the oil does not rise to above 90° F., and that, therefore, an oil which does not evolve an explosive vapour below 100°, and does not take fire itself below 110°, is perfectly safe.

The author next touches the subject of legislation on this matter, first quoting, from the British Acts of Parliament, the directions for applying the flashing test to samples of petroleum oil, and afterwards alluding to the Bill before the State Senate of New York, and discussing some points of interest to the inhabitants of that state. Very properly, the author reflects upon the bill as simply to be made applicable to New York and Brooklyn; it is not only against general good policy, but is a downright infringement of a fundamental constitutional principle, to legislate only for a portion of the inhabitants of a state, or even to make so-called Permissive Acts. These are simply a remnant of feudalism which made slaves and serfs of the bulk of the people, inhabiting the same country, and acknowledging the same person as sovereign.

## CORRESPONDENCE.

### LOSS OF SODIUM IN SODA-WORKS.

To the Editor of the Chemical News.

SIR,—In the "Chemical Notices from Foreign Sources" given in the CHEMICAL NEWS (vol. xxii., p. 21) appears a brief abstract of the results obtained by M. A. Scheurer-Kestner on the "Loss of Sodium Resulting from its Manufacture according to Le Blanc's Process." The results arrived at by this chemist (viz., that the formation of in-

soluble sodic compounds which remain in the lixiviated refuse constitutes a very large item in the total causes of loss, and that the volatilisation of sodium is inappreciable) are, in the main, identical with those formerly obtained by the writer, and published in the *Journal of the Chemical Society* (August, 1867); the results obtained during the manufacture of some 5000 tons of soda-ash being:—

#### PREVIOUS TO LIXIVIATION.

	Per cent.
Undecomposed sodic sulphate .. ..	3.49
Insoluble sodic compounds.. ..	5.44
Vapourisation of sodic compounds, &c. ..	1.14

#### DURING AND AFTER LIXIVIATION.

Soluble alkali left in vat-waste .. ..	3.16
Oxidation of sulphide .. ..	inappreciable
Leakage and losses during white-ash process	6.56

Total loss .. .. 20.24

I am, &c.,

C. R. A. WRIGHT, D.Sc.

Washington Chemical Works, Washington Station,  
Durham, July 11th, 1870.

## MISCELLANEOUS.

London Institution.—Our readers will be glad to hear that Mr. J. C. Brough has been appointed Librarian and General Superintendent of the above-named institution.

Utility of Lightning Conductors.—The *Moniteur Belge* of the 6th inst. contains the following:—The powder magazine Santo-Spirito, at Venice, containing no less than 300,000 kilos. (fully 300 tons) of gunpowder, was struck by lightning the other day. The electric discharge fortunately fell on the lightning conductor, the platinum point of which was molten and the rod split and twisted, but no other damage was sustained. The quantity of powder present, if exploded, would go far to lay in ruins ten cities of the size of Venice.

Quality of the Gas Supplied to the Metropolis.—Dr. Letheby, the Chief Gas Examiner for the Metropolis, has recently reported to the Corporation and to the Metropolitan Board of Works on the quality of the gas supplied to the Metropolis by the Chartered, the Great Central, and the City of London Gas Companies. The average illuminating power of the gas, when burnt at the rate of five cubic feet per hour from Sugg's improved Argand burner has been as follows:—The common gas of the City Company has been equal to 17.55 standard sperm candles; that of the Chartered Company, at Leadenhall Street, has been 17.44 candles, at Gray's Inn Lane, 16.92 candles, at Arundell Street, Haymarket, 17.14 candles; and that of the Great Central Company, 17.82 candles. The illuminating power of the Cannel gas of the Chartered Company has been 24.44 candles, and of the City Company 28 candles. As regards impurity, Dr. Letheby reports that the gas of all the companies has been constantly free from sulphuretted hydrogen, although the amount of sulphur in other form than the last named, has varied considerably; for while it amounted to an average of only 12.29 grains per 100 cubic feet of the Great Central gas, and 12.71 grains per 100 feet of the Cannel gas from the City Works, it reached to 22.13 grains, 22.39 grains, and 29.65 grains in the gas of the Chartered Company at the three testing stations of Leadenhall Street, Gray's Inn Lane, and Arundell Street. In connection with this important part of the subject, Dr. Letheby reports that the testing of the gas of the several companies for sulphur during the last twelve months has shown how this obnoxious impurity may be influenced by different methods of purification; for in the case of common gas, the



average proportion of sulphur in the gas from the Great Central Works has only been 12.91 grains per 100 cubic feet, whereas in the gas of the Chartered Company it has ranged from 21.41 grains to 28.59 grains per 100 cubic feet—the average for all the stations of that company being 24.77 grains, and of the City Company 19.75 grains. And again, although the average amount of sulphur in the Cannel gas of the City Company has been but 10.29 grains per 100 cubic feet, it has reached to an average of 24.48 grains in that of the Chartered Company. These large differences are, according to Dr. Letheby, entirely owing to the different methods of purification, and he directs attention to it as a matter of great practical importance.

The other impurity, ammonia, has been always absent from the common and the Cannel gas of the City Company, but it has been frequently present in the gas of the other companies, averaging 0.38 of a grain per 100 cubic feet of the Great Central gas, and from 1.87 to 3.68 grains in that of the gas from the different stations of the Chartered Company; in fact, it has exceeded the prescribed amount of 5 grains per 100 cubic feet, on seven occasions in the Chartered gas at Leadenhall Street, and on nine occasions in the same company's gas at Gray's Inn Lane.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

*Under this heading will be found an encyclopaedic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

*Comptes Rendus des Séances de l'Académie des Sciences, July 4, 1870.*

This number opens with a report on the—

**Pyramids of Villejuif and Juvisy.**—M. Delaunay.—In the year 1670, M. Picard took, as basis of his geodesical triangulations, the nearly straight roadway which joins together the communes of Villejuif and Juvisy, a distance of 5748 toises (1 toise is equal to 6 feet 6 inches English measure). This basis having been verified in 1740, by J. Cassini and A. La Caille, they erected there, at the expense of an old scientific institution, re-modelled afterwards into the Academy of Sciences, two pyramids, which, having become out of repair, have now been restored, and on each is placed a black marble slab, containing, in gilt letters, simply the following inscription (translated):—"Pyramid of Villejuif; northern limit of the geodesical basis of Villejuif to Juvisy. 1670—Picard. 1740—J. Cassini and La Caille. Property of the Academy of Sciences." The inscription on the Juvisy pyramid is similar. Both these monuments are about 10 metres high, and are situated on the side of the carriage road leading from Paris to Fontainebleau. There is a very great deal of scientific interest attached to the basis alluded to, it having been the first work of the kind ever accurately done, and thus the basis of nearly all such measurements.

**Kinds of Rocks met with during the Boring of the Tunnel through the Western Alps between Modane and Bardonnèche.**—Elie de Beaumont.—A very lengthy paper, accompanied by a catalogue of the specimens of rocks which have been presented to the Academy, and will in future form a most important mineralogical collection; the more so, because the tunnel, usually known as the Mont Cenis tunnel, will be lined over its entire length (12,220 metres) with bricks and tiles, and the rocks will be hid. As may be expected, this paper, by so eminent a geologist and mineralogist, is of very great value.

**Answer to the Remarks made by M. H. Sainte-Claire Deville on the Variations of Temperature Produced by the Mixing of Two Liquids.**—Dr. Jamin.—And—

**Reply to that Memoir by M. H. Sainte-Claire Deville.**—We can only give the titles of these polemical discussions between the rival physicists.

**Action of Water upon Iron, and of Hydrogen upon Oxide of Iron.**—(Third memoir on this subject).—H. Sainte-Claire Deville.—The author resumes the results of his experiments in the following terms:—The increase of the tension of hydrogen formed by the con-

tact of iron and steam, is a continuous phenomenon when the tension of the steam is made to vary progressively without any variation of the temperature of the iron. That the tension of the hydrogen corresponding to an invariable tension of steam, decreases continually when the temperature increases progressively. That the same laws are observed at the inverse phenomenon of the reduction of oxide of iron by hydrogen.

**Isomers of Cyanuric Ethers.**—Reply to M. S. Cloëz, by Prof. A. W. Hofmann.

**Meteorology of the Spring of the Current Year.**—M. Chapelas.—The author considers (1) the temperature, (2) the direction of the winds, (3) the moisture, and draws up a series of comparisons, taken from the meteorological records of former years, to elucidate the meteorological conditions of last spring.

**On a Property of the Volta Electrical Condenser hitherto Unnoticed.**—P. Volpicelli.—An algebraico-physical memoir.

**Deluc's Thermometer.**—M. Legrand.—A discussion on the precision of a thermometer scale now almost obsolete, so that this paper is of very little interest.

**Compressibility and Expansion of Gases.**—Dr. Amagat.

**Phospho-Platinic Compounds.**—P. Schützenberger.—The author states that he has succeeded in isolating the radical of phospho-platinic compounds before alluded to. The radical turns out to be a black-coloured body, insoluble in water and soluble in alcohol; the formula being  $\text{Ph}(\text{C}_2\text{H}_5\text{O})_3\text{Pt}$ .

**Carbonic and Alcoholic Fermentation of Acetate of Soda and Oxalate of Ammonia.**—A. Béchamp.—This lengthy memoir is divided into the following sections:—Carbonic and alcoholic fermentation of acetate of soda; carbonic and alcoholic fermentation of oxalate of ammonia; production of alcohol from the elements of air and water. As regards this latter point, the author asserts that he took very pure distilled water, and poured it into a flask, the mouth of which was simply covered by a piece of paper; after having been set aside for some six months, the author has extracted enough alcohol from the water to ignite. He supposes the cause of this phenomenon to be the formation of microzymas, which induced fermentation. Some ammonia and a volatile acid were simultaneously formed.

**Climate of the Elsass and the Vosges.**—C. Grad.

**Observation on an Unequal Production and Difference of Composition of the Milk from the Breasts of the same Woman.**—L. Sourdat.—While the quantity of sugar and salts contained in the milk of the two breasts of the same woman does not perceptibly vary, the author has found that the milk of the right breast contains more butter and caseine than that of the left breast, the difference being as much as in the ratio of 9 to 1.

*Bulletin de la Société d'Encouragement pour l'Industrie Nationale, No. 208, April, 1870.*

This number contains the following original memoirs and papers relating to physico-chemical and collateral sciences:—

**Report, by M. Tresca, on the System of Water-Wheels Invented by M. Sagebien.**—A very important memoir, illustrated by engravings, on this subject, since the inventor has successfully solved the problem of applying usefully low falls, or weak currents of water, so as to become, by means of the wheels arranged by him, fit for very cheap, yet effective, motive power.

**Report, by M. Clerget, on an Apparatus wherein a Continuous Jet of Liquid, and a Gradually Increasing or Decreasing Temperature, are Applied to the Cleansing of Linen Fabrics.**—Description, illustrated by engravings, of an apparatus invented by M. J. Decoudun, 77, Rue Montreuil, Paris.

**Manufacture of Special Kinds of Cast-Iron.**—S. Jordan.—The author discusses, at great length, the calorific phenomena produced by the injection of compressed air, steam, or oxygen into a mass of molten iron, from a multiple of jets.

**Effervescing Cyder.**—MM. Brosse and Lamfrey.—Cyder, it is well known, becomes, when bottled, after being freshly-made and pure, effervescing to a high degree, but then, also, a highly-intoxicating beverage. The authors apply to cyder a preparation (not specified) whereby it becomes effervescent and a pleasant useful beverage which keeps well for any length of time.

**Gaize.**—J. Desnoyers.—The substance known as gaize, or *pierre morte*, is a mineral largely met with in the department of the Ardennes, where it forms a deposit of some 100 metres' thickness. Its sp. gr. is 1.48, and it consists, in 100 parts, of—Soluble silica, 44.8; insoluble silica, 42.0; alumina, 5.1; peroxide of iron, 2.5; lime, a trace; hygroscopic and combined water, together, 5.4. It is, on being dug up, quite soft, so that it can be cut with a knife, but becomes hard on drying, and very hard when exposed to red-heat, whereby its specific gravity is reduced to 1.44. This material is essentially a substance capable of withstanding high temperatures; and the author exhibits crucibles made from the gaize, which have been used successfully for melting iron. Dr. La Salvétat, the celebrated chemist of the Imperial Porcelain Works, at Sèvres, states that layers of similar material exist in the central parts of France, likewise deposited in the cretaceous formation; he also states that these minerals are of great value for the construction of blast and other furnaces.

**Alloy of Cobalt and Manganese.**—A. Valenciennes.—The author exhibits, at the meeting of the Society, samples of metallic cobalt and manganese, and alloys thereof, as well as alloys of copper and manganese, which resemble those of copper and tin. The alloys of cobalt



and manganese are not likely ever to become (the author states) objects of general use; but those of manganese and copper possess properties whereby they may become generally employed.

*Annales de Chimie et de Physique*, June, 1870.

This number contains the following original papers and memoirs:—

**Superficial Tension of Liquids, as deduced from Certain Movements which Take Place on their Surface.**—G. van der Mensbrugghe.—The concluding portion of this memoir.

**Indices of Refraction of Gases and Vapours, and on the Measurement of their Dispersion.**—Dr. M. Croullebois.—This lengthy essay is divided into the following chapters:—The history of the subject; description of instruments, illustrated by woodcuts; indices of gases for homogeneous lights; dispersion of gases; first method, and observations thereon; second method; indices of gases in white light; indices of vapours in homogeneous and white lights; dispersion of vapours, method employed, and description of apparatus, illustrated by woodcuts.

**Apparatus Arranged for the Demonstration of the Physical Properties of Vapours.**—F. da Fonseca Benevides.—This paper cannot be understood without the reproduction of the annexed cut. The contrivance is simple and effective, and suited to demonstrate, experimentally—The laws of the boiling of liquids and absorption of latent heat; the influence of pressure upon the temperature of the boiling liquid; condensation of vapours (steam and others); development of latent heat; relation between pressure and temperature; production of cold by the dilatation of vapours under high pressure; use of steam as motive power; action of the Giffard's injector.

**Evaporation of Water and the Decomposition of Carbonic Acid by the Leaves of Plants and Trees.**—P. P. Dehérain.—This lengthy memoir, containing a series of results of experiments exhibited in a tabulated form, is divided into the following sections:—History of the subject; method of experimenting; quantity of water evaporated by leaves exposed to sunlight in one hour; influence of light upon the evaporation. The luminous rays which provoke the evaporation also cause the decomposition of the carbonic acid. Rays of light of the same intensity, but different colour, exert different action, as regards the decomposition of carbonic acid and the exhalation of water.

**Estimation of Graphite in Carburetted Iron.**—M. Boussingault.—The results of the experiments and analyses detailed at length in this paper, may be summarised as follows:—(1) When a carburetted iron is dissolved in chlorhydric acid, the total quantity of the carbon combined with the metal is eliminated, while the free carbon remains mixed with the other substances insoluble in the acid. (2) Since the residue left by a grey cast-iron, treated by hydrochloric acid, contains a portion of the silicium which was combined with the iron in the state of silica, that residue does not contain any graphitoid silicium nor protoxide of silicium; the estimation of the silica in the residue does not represent the whole of the silicium contained in the cast-iron, because a portion of the silica remains in the acid liquid. (3) That the process based upon the difference of combustibility of the combined carbon and graphite is sufficiently exact to estimate the two kinds of carbon obtained by the action of bichloride of mercury upon the carbonaceous residue of cast-iron or steel.

*Annalen der Physik und Chemie*, von Poggendorff, No. 5, 1870.

This number contains the following original papers and memoirs—

**Sound Emitted from Heated Tubes, and on the Oscillation of Air in Pipes of Different Shape.**—Dr. C. Sondhauss.

**On Chromates.**—C. Freese.—The author has studied some of the hitherto less known salts of chromic acid. Among these we notice—Normal chromate of silver; Attention is called to the mode of precipitating this salt, which differs in composition with the concentration of the silver and chromate solution employed; the normal salt contains 65 per cent of silver and 15.83 per cent of chromic acid. A basic chromate of silver does not exist; a bichromate is well known. Chromate of protoxide of mercury,  $\text{HgCr}_4\text{O}_7$ , in 100 parts—Hg, 77.49; Cr, 10.11; O, 12.40. Chromate of deutoxide of mercury,  $3\text{HgCr}_6\text{O}_{11}$ , in 100 parts—Hg, 80.19; Cr, 6.98; O, 12.83. The chromates of copper are treated of at great length, and the subject is to be continued in a following number.

**Thermo-Chemical Researches.**—J. Thomsen.—The continuation of the author's very lengthy memoir on this subject, this portion treating on the acids of nitrogen, phosphorus, and arsenic.

**Continued Researches on Liquid Conductors of Galvanic Electricity.**—J. W. Müller.—The first instalment of a lengthy essay on this subject, subdivided as follows:—Introduction and description of method of investigation, illustrated by diagrams; on the tension of liquid conductors in general; the non-dependence of the tension of alkali and acid upon their chemical combination; first general laws of the direction of the current, and of the electro-motive force of the acido-alkaline conductors; tensions of the alkalies and the acid, and of the salts formed by their union; saline solutions at the end of each pair of metals; effect of dilution of saline solution; effect of concentration of saline solution.

**Investigation on the Electric Dust Figures (Staubfiguren).**—W. von Bezold.

**Laws of the Formation of Kundt's Dust Figure.**—T. Karrass.—These two papers refer to what are sometimes termed Lichtenberg's

figures, but the contents of neither of them are suited for any useful abstraction.

**Description of Electrophoric Machine Suitable to Charge Batteries.**—P. Riess.—Illustrated with woodcuts.

**Measurement of the Absorption of Light by Transparent Media by means of the Spectrum Apparatus.**—Dr. C. Vierordt.

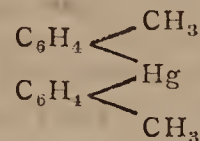
**Observations on Induction Sparks.**—Dr. A. Weinhold.

*Annalen der Chemie und Pharmacie*, May, 1870.

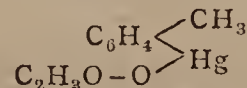
This number contains the following original memoirs and papers:—

**Researches on some of the Derivatives of Cinnamic Acid.**—C. Glaser.—Third part of this essay, divided into the following sections:—Phenyl-propionic acid,  $\text{C}_9\text{H}_8\text{O}_2$ ; formation of phenyl-propionic acid from  $\beta$  bromstyrol; formation of phenyl-propionic acid from  $\alpha$  bromo-cinnamic acid; constitution of phenyl-propionic acid; formation of acetenyl-benzol from phenyl-propionic acid; formation of acetenyl-benzol from styrol; metallic combinations of acetenyl-benzol and its conversions (diacetenyl-phenyl; synthesis of phenyl-propionic acid); derivatives from styrol; chlorinated styrols; brominated styrols; conclusions and speculative discussions.

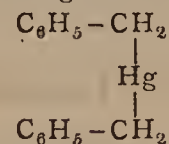
**On Mercurio-Ditolyl.**—E. Dreher and R. Otto.—This compound—



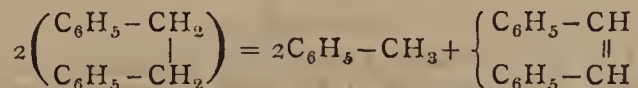
is obtained by the action of sodium-amalgam upon brom-toluol. It is, as crystallised from boiling benzol, a beautifully white body, exhibiting a strong diamond-like lustre, and crystallising in large rhombic-shaped crystals, insoluble in water, difficultly so in alcohol, best in benzol, chloroform, and sulphide of carbon, and fuses at  $235^\circ$ . The authors describe, at length, the action of the haloids, and of nitric, hydrochloric, hydriodic, and sulphuric acid upon this body; and next treat of acetic acid-mercurio-monotolyl—



a white crystalline substance, fusing at  $153^\circ$ ; insoluble in cold, but more soluble in boiling water; best soluble in alcohol, sulphide of carbon, and benzol. The paper winds up with an account of researches made with the view of preparing mercurio-dibenzyl—



**Behaviour of Dibenzyl at a High Temperature.**—E. Dreher and R. Otto.—The main fact of interest in this paper is that dibenzyl is split up, by heat, into toluol and toluylene, according to the formulæ—



**Conversion of Thiophenol (Phenyl-Sulphydride) into Phenyl-Bisulphide.**—E. Dreher and R. Otto.—After referring to the different methods of effecting the conversion alluded to, the authors state that this object can also be attained by heating the mercurial compound,  $(\text{C}_6\text{H}_5)_2\text{S}_2\text{Hg} = (\text{C}_6\text{H}_5)_2\text{S}_2 + \text{Hg}$ .

**Two Isomeric Pentachlorbenzols and Bichlorbenzol-Chloride.**—R. Otto.

**Mercurio-Dinaphthyl.**—R. Otto.—This paper is divided into the following sections:—Preparation of mercurio-dinaphthyl; action of iodine upon mercurio-dinaphthyl; mercurio-mononaphthyl-bromide; behaviour of mercurio-mononaphthyl-iodide with nascent hydrogen and sodium-amalgam; formic and butyric acids, mercurio-mononaphthyl.

**Sulpho-Toluide.**—R. Otto and A. Gruber.—Sulpho-toluide,  $\text{C}_{11}\text{H}_{14}\text{SO}_2$ , is, when obtained in crystalline state from benzol, a solid body, exhibiting klinorhombic-shaped prismatic crystals; fuses at  $155^\circ$ ; insoluble in water, and difficultly soluble in cold alcohol and ether; rather more soluble in boiling alcohol, benzol, and chloroform. When submitted to the action of heat, in small quantities, it is volatile without decomposition. Heated along with concentrated sulphuric acid, it is gradually converted into toluol-sulphuric acid. The authors quote, at length, the various reactions of this body with several reagents, and discuss its constitution.

**Acetic Acid Mercurio-Monomethyl and Acetic Acid Mercurio-Monoethyl.**—R. Otto.

**Preparation of Organic Sulphur Compounds by means of Hyposulphite of Sodium.**—R. Otto.—When ethyl-alcohol is heated for twenty hours, in a sealed tube, with a hot concentrated solution of hyposulphite of soda, it is converted into mercaptan. Iodethyl, heated for two hours to  $150^\circ$ , in a sealed tube, is converted into sulphur compounds, and iodide of sodium is formed.

**Diamido-Nitrophenylic Acid, a New Derivative from Picric Acid.**—P. Griess.

**Azobenzol-Sulphuric Acid.**—P. Griess.

**Ozone and Antozone.**—C. Engler and O. Nasse.

**Constitution of Arbutine.**—H. Schiff.



**Action of Hypochlorous Acid upon the Chloride of Allyl.**—H. von Geyerfelt.

**New Mode of Synthesis of Naphthalin-Carboxylic Acid.**—A. Eghis.

**New Method of Estimation of Grape Sugar.**—K. Knapp.—This method is based upon the fact that an alkaline solution of cyanide of mercury is completely reduced to the metallic state by grape sugar. The method is executed as follows:—10 grms. of pure and dry bicyanide of mercury are dissolved in pure distilled water; to this solution are added 100 c.c. of caustic soda solution (sp. gr. 1.145); and, next, as much distilled water is added as will be required to make a bulk of 1000 c.c. A series of experiments made by the author brought to light the fact that 400 milligrams of cyanide of mercury are, when in alkaline and boiling solution, completely reduced to metal by 100 milligrams of pure grape sugar. The titration is done as in Fehling's method—40 c.c. of the alkaline cyanide solution are boiled in a porcelain basin; and the sugar solution (not stronger than about half a per cent) is added until all the mercury is precipitated. In order to test the course of the operation, a single small drop of the fluid is put upon a piece of Swedish filtering paper stretched over the mouth of a small beaker-glass, while the bottom of that glass is covered with rather strong sulphide of ammonium. As long as any cyanide remains undecomposed, a brownish spot will appear. The author states that, with a little practice, even 1-10th c.c. of the above dilute sugar solution can be readily estimated.

Cosmos, June 18, 1870.

**Bicoque Insubmersible.**—J. Chabassière.—The author describes, under the above title, at great length, a peculiarly-constructed ship, so contrived as to be really incapable of foundering; and, even when knocked to pieces, its component parts (the passengers' cabins) are so constructed as to constitute floating vessels, each separately. Experimental trials with a vessel made according to the author's suggestions are being performed at Algiers.

**The Silex (Flints) of the Chalk considered as Living Bodies.**—Rev. P. Sun.—The author thinks that the flints of the chalk may be considered as being the work and production of living beings, similar to the coral reefs found in the ocean, and that, after the death of the microzymas (elementary living organisms) present in the flint, the latter becomes what is termed gaize, or dead stone. This view is strongly combated by many eminent geologists of our time.

**Scientific Visit to be made to England.**—The French Minister of Marine has ordered that a number of select officers, of all grades of the French navy, shall proceed to England, with the view of visiting, not only dockyards, but also all scientific establishments and institutions which are related to, or work for, the benefit of navies (war and mercantile), and to make a report of their proceedings and investigations.

June 25, 1870.

This number does not contain any original papers or matter relating to physico-chemical sciences.

July 2, 1870.

**Vintage of Wines.**—J. Guyot.—The author's chief aim is to point out, as regards wine, the danger to health of adding to these fluids (as is usually done for the wine intended for exportation), alcohol, to a greater or less extent. The author expatiates upon the fact that all animal and vegetable products, when brought to a state of chemical purity and stability, are unfit to serve as food, and that the wine consumed in the country districts is sedulously left *au naturel*, even if its quality is mediocre. All who are acquainted with wine-growing countries, and the trade there, know very well that, for every special port of shipment (at least, those belonging to one and the same country), wine is purposely (not as an adulteration, but as a necessity which has sprung into use) prepared for such or such port of shipment, and that this essentially consists in the addition of more or less alcohol, and, sometimes, wines previously boiled with sugar for some time. The author observes that, to make a wine keep is to kill it, it being a well-known fact that many small wines are only good during their first year of existence, but do not last above a twelvemonth. Such a wine is active; and it is just that activity which makes it a wholesome beverage which neither affects the head nor the stomach.

**Proposed Law Concerning the Free Teaching of Higher Sciences.**—This paper, too long for any but brief notice, is an evident proof of that pre-eminence which the Frenchmen possess of making laws so as to be brief, readily understood by all, and worded so as not to lead to litigation or difficulties. Of course, from men of the stamp of MM. Guizot, Dumas, Duruy, and others, no one could expect but a highly-efficient plan, which will, undoubtedly, be a great boon to "La Belle France."

**Proposal to Decrease the Existing Drought by Accelerating the Melting and Floating-Down of the Ice in the Polar Seas.**—V. Prow.—The author seriously proposes to blow up, by means of dynamite, icebergs and ice-fields in such masses, in the Arctic Regions, as to cause the loose ice to float into the Atlantic, and there to cause, by its rapid melting, such a cooling of the atmosphere and sea as to conduce to the formation of rain. The author has certainly never witnessed the almost total inefficiency of both heavy bombardment of ice-dams, or attempts to blow them to fragments by explosions of gunpowder. Some twenty-four years ago, thaw having set in, experiments were made (as had been often done before) to remove, by the means alluded to, ice-dams on the lower Rhine and some of its branches, the removal of which was absolutely required in order to prevent serious inundations and breaking of embankments; but, although directed by

military men of great skill in these matters, these means proved quite ineffective, and it was only by natural causes that the obstruction was removed in time.

**Laboratory Accident.**—It appears that a pupil of the School of Pharmacy, named Tronçay, was engaged in heating, in a glass tube, a solution of hyposulphite of soda mixed with nitric acid. While trying to smell, at the mouth of the tube, the odour of the sulphurous acid given off, a sudden ebullition of the liquid took place; as a consequence of which, the contents of the tube were forced out at its open end, with the sad result of seriously burning the eyes of the young man occupied with the experiment. Notwithstanding the immediate aid given by a medical man who happened to be at the school at the time, the young man has lost his eyesight.

**Statistics of Berlin University.**—Without specifying for all faculties, this University now has a professorial staff of 165 men, the largest number being engaged with the philosophy faculty (literature and sciences together), which has 26 ordinary and 31 extraordinary professors, and 20 private (graduated) teachers. In addition, there are 3 masters of living languages, and 3 masters for dancing, music, and gymnastics.

**A Burning Mountain.**—S. Mcunier.—The author states that Mount Vuache (Savoie), near Savigny, has been, for a fortnight past, actually burning—that is to say, it is not, as might be, some fire of dry grass, heather, or trees, but the body of the mountain itself is in flame, and emits a dense smoke to such an extent, that a surface of some 800 square metres is red-hot, and so frightens the people who live near, that the true cause has not been ascertained at present. Some think the mountain has become a volcano.

**Application of the Ash and Small Coke of Gas-Works for Brick-Making.**—O. Wagner.—The author mixes from 10 to 12 parts of the ash and cinders with 1 part of lime, after having first taken care to break up the small pieces of coke, so as to be of no more than about 5 centimetres cubical size. The mass is mixed with some water, and next mixed in a pug-mill, and, after having become stiff enough, formed into bricks by a brick-making machine. The bricks are slowly, but carefully, dried, and are, after drying, fit for use, making very solid walls, while the material is very light, and especially suited for partition walls.

## NOTES AND QUERIES.

**Cement.**—Can any of your correspondents kindly inform me if there is any known cement that will resist boiling nitric acid?—C. H.

**Benzol.**—Can any one inform me what kind of apparatus is required for testing the percentage of benzol in naphtha, and where to get them and a book of directions how to test it?—A SUBSCRIBER.

**Inflammable Liquids.**—Can you inform me whether there is any liquid preparation known that will take fire, spontaneously, on coming into contact with water; or whether there are two liquids, by themselves inflammable, but otherwise when brought together?—G. G. M.

**Extract of Meat.**—Will you kindly inform me how the extract of meat, now being sold under the name of "Liebig's extract," &c., is made? It appears to be a totally different article to anything like the old-fashioned concentrated soup.—THOS. WELLS.

**Work on Sulphur.**—(Reply to "George Crampton")—You will find in the latest edition of Payen's "Chimie Industrielle" what you desire; but bear in mind that, unless you have fuel at an exceedingly cheap rate, the extraction of sulphur from the substances alluded to does not pay. You can inspect the work alluded to at the Library of the Commissioners of Patents.

**Estimating Sulphide and Sulphite of Calcium.**—(Reply to "Alkali.")—You cannot mean exactly what this question states. It must be evident that the process of oxidation will certainly result in the formation of sulphate of lime, rather than of sulphite, and there will then be no possibility of estimating what, previous to that oxidation, was already a far more complex mixture of substances than you suppose; and you will readily understand, therefore, that there is no such method as you desire to be informed upon.

## TO CORRESPONDENTS.

**Chrome Alum.**—This is common alum in which chromium takes the place of aluminium.

**A Subscriber.**—Good ventilation is your only remedy.

**Alfred W. Bennett.**—We were glad to hear from you.

**E. Sonstadt.**—Thanks for your communication. We shall be glad to have your complete paper.

**George Gore, F.R.S.**—We will send you a reply by post.

**L'Abbé F. Moigno.**—You have doubtless received the parcel ere this. After making the enquiries, we will write to you.

**A. H. Church.**—Received, with thanks.

**The Secretary of the Aeronautical Society of Great Britain** is thanked for his communication.

**W. H. Walenn.**—Next week.

**A Subscriber from the first.**—The address of Mr. Siemens is 3, Great George Street, Westminster. You will find a complete description of his furnace, and its successful use, in Vol. III. of "A Practical Treatise on Metallurgy," by Crookes and Rührg, published by Longmans and Co.

**The Honourable the Commissioners of Patents, Washington.**—We have received, through Mr. B. F. Stevens, the four volumes of your Reports for the year 1867; for which please accept our thanks.

**S. E. Phillips.**—Your paper shall, if possible, be inserted next week.



# THE CHEMICAL NEWS.

VOL. XXII. No. 556.

## NOTE ON SOME NEW DERIVATIVES OF ANTHRACENE.

By W. H. PERKIN, F.R.S.

IN the latter part of last year, when experimenting upon the production of alizarine from anthracene, I obtained some interesting reactions, which I described in a Patent dated November 17th, 1869. In this note I propose to give a short account of the chemical changes which take place in some of these reactions, leaving the experimental details to a future occasion.

When dichloranthracene is mixed with fuming sulphuric acid, it gradually dissolves, forming a green fluid, which, upon dilution with water, becomes yellow. The product thus obtained contains one, if not two, new acids, viz., disulphodichloranthracenic acid,  $C_{14}H_8Cl_2SO_3$ , and monosulphodichloranthracenic acid,  $C_{14}H_8Cl_2SO_3$ . The formula of the former I have well established, but the existence of the latter is not definitely settled.

Disulphodichloranthracenic acid is of a yellow or orange colour, and easily soluble in water. It is remarkable for the great beauty and intensity of its fluorescence when in dilute solutions. It is dibasic, and forms salts of the formula  $C_{14}H_6Cl_2M_2SO_3$ . Many of these are difficultly soluble in water, and of a yellow or orange colour.

Dibromanthracene likewise dissolves in fuming sulphuric acid, forming a green fluid containing compounds analogous to those obtained from dichloranthracene, and possessing a strong fluorescence when dissolved in water.

The acids obtained from chlorinated or brominated anthracene, when subjected to the action of oxidising agents, part with their chlorine or bromine, exchanging it for oxygen, yielding disulphanthraquinonic acid,\* thus:—



Disulphodichloranthracenic acid.

Disulphanthraquinonic acid.

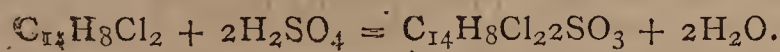


Disulphodibromanthracenic acid.

Disulphanthraquinonic acid.

When oxidising these sulpho-acids, the termination of the operation is easily seen by the solutions losing their fluorescence.

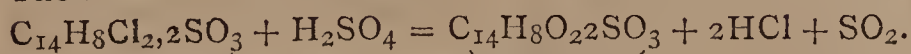
If dichlor- or dibromanthracene be treated with concentrated or fuming sulphuric acid, and the temperature gradually raised, the disulpho-acids are first formed and then decompose, yielding disulphanthraquinonic acid, thus:—



Dichloranthracene.

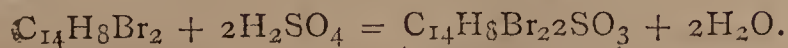
Disulphodichloranthracenic acid.

Then—



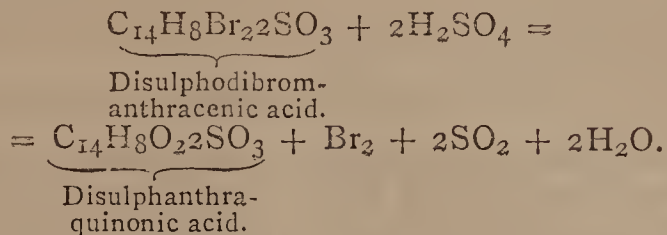
Disulphodichloranthracenic acid.

Disulphoanthraquinonic acid.



Dibromanthracene.

Disulphodibromanthracenic acid.



During my experiments I have repeatedly analysed dichloranthracene, and my results agree with those of Graebe and Liebermann, showing that this body is a substitution product of anthracene, and not a product of addition.

Like anthracene, dichloranthracene combines with picric acid, forming a red crystalline product, which, from analysis, appears to consist of  $C_{14}H_8Cl_2, C_6H_3(NO_2)_3O$ .

## AIR-POLLUTION BY CHEMICAL WORKS.

(Concluded from p. 27.)

AMONG chemical-works, the largest, and those capable of doing most harm to vegetation, are the alkali-works. In these works, soda, in its various forms of ash, carbonate, bicarbonate, crystal, or caustic, is extracted from common salt. Common salt consists of soda in combination with muriatic acid. When it is mixed with sulphuric acid, and heated, muriatic acid is driven off as a gas. In the earlier days of the soda-manufacture, this acid was considered as a waste product, to be got rid of as speedily as possible. The easiest way was to let it pass into the chimney, and thence into the surrounding atmosphere. Complaints were soon made that trees in the neighbourhood were injured. The manufacturer therefore raised his chimney, building it so high that the acid might be carried away to a great distance by the wind, and its effects lost sight of. The result of this effort was not successful. On wet days, the rain passing through the smoke would wash down the acid, and fall in burning drops even at the foot of the chimney; while, on fine days, the smoke would travel farther, and, though much spread out, still powerful for evil, would carry on its destruction over a larger area. A wiser plan was next adopted. By the use of the now-famous Gossage condensing-towers, the acid-vapours were washed out of the smoke, and kept from contaminating the air altogether. Those alkali-manufacturers who carried out this method well sent out scarcely any acid-vapour to damage the farmers' crops. Some of the manufacturers, however, were behindhand in the movement, and, either from want of skill or of enterprise, did not condense their acid-vapours. Of the efficiency of this condensation in individual cases the farmer could not judge; he found that his crops were still damaged, and therefore brought his action as before, possibly to recover from an innocent party. At this point the Legislature stepped in, and, in the Alkali Act of 1863, passed a measure which has worked well in the interests of both the manufacturers and the agriculturists. The Act announces it to be the duty of the manufacturer to condense 95 per cent of the muriatic acid he produces, and fixes a penalty of £50 for each omission, raising the penalty to £100 after the first conviction. Inspectors are appointed, whose duty it is to visit the works from time to time, and ascertain that the provisions of the Act are carried out. It should be noticed that the Legislature, in passing this Act, stepped out of its accustomed course. The common law maxim is that, for every injury a man may receive, he has his remedy against some one: he must, however, receive the injury before he can seek his remedy. But, in this case, as it already has been shown, much injury may be done which has no remedy. Who can replace an oak-tree of 100 years' growth, and restore the waving woods which adorned the hill-side? The law, therefore, here steps in beforehand; and, no sooner does the inspector find that 95 per cent of the acid is not condensed, than he stops the process under the penalties mentioned. The new law

\* MM. Graebe and Liebermann have lately corroborated my results, and obtained disulphanthraquinonic acid by heating dichlor- and dibromanthracene with sulphuric acid. They do not, however, seem to have recognised the intermediate part of the reaction, viz., the formation of the dichloro- and dibromo-sulpho-acids of anthracene. (*Ber. d. D. Chem. Gesellsch.*, July, 1870, p. 636).



has been found to work very well. It has enforced the condensation of muriatic acid, to the benefit both of the manufacturer himself and of the public. It has protected the agriculturist against the manufacturer, and the manufacturer against the agriculturist. The inspector is received as a friend by both sides; he protects the farmer's interests by enforcing care on the part of the manufacturer, and he protects the manufacturer's interest by proclaiming the extent to which he carries the suppression of noxious vapours. The Act has had the effect of bringing up the hindermost manufacturer to the rank of the most skilful. Before this legislation took place, many manufacturers condensed a portion of their muriatic acid; now they all condense, not a small portion only, but fully 95 per cent, some, indeed, habitually condense 99 per cent. The manufacturer finds the visits of the inspector an assistance to him in keeping his condensing-apparatus in efficient order; and an amount of acid escaping which would pass unnoticed by the master or his workpeople is detected by the inspector. It should be understood that, to point out leakage of muriatic acid, is to point out waste; for this acid is needed in the manufacture of bleaching-powder and other products. The amount of acid thus saved by the operation of the Act is very large. One manufacturer sells muriatic acid annually to the amount of £1500—acid which, previous to the passing of the Act, was sent up the main chimneys of the works, to the destruction of all surrounding vegetation.

It may now be asked, in general terms, Has the Alkali Act, this somewhat experimental law, succeeded? does it accomplish the work it was intended to do? The reply is that it has done all, and more, than its promoters or those who understood its provisions expected. But probably the public generally are not satisfied: they fail to understand that a law which professes to shield them from muriatic acid cannot also defend them from chlorine, sulphurous acid, sulphide of hydrogen, and the host of nameless gases by which their noses and their gardens are assailed; still less can they understand that an Act which should prevent the emission of muriatic acid from the chimney of an alkali-works cannot also prevent the escape of the same acid from copper-extracting works, a bottle-factory, or a pottery.

The Act must, however, not be blamed for omitting to do that which it was never framed to accomplish. Let us be glad that a step has been gained—that one noxious gas has been measured and suppressed.

Some instances have occurred where manufacturers who are not alkali-makers have desired to place their factories under the inspector appointed under the Alkali Act: their object being first to know if, in his opinion, they were sending out an injurious amount of noxious vapour; then, having diminished it so as to meet with his approval, to gain his advocacy and defence when harrassed by their natural enemies the farmers. This has brought a certain amount of volunteer-work on the inspectors, which they have cheerfully borne on account of the obvious good they could accomplish by diminishing, on the one hand, the escape of noxious acids, and preventing litigation on the other.

In districts such as that around St. Helen's, in Lancashire, where alkali-works and copper-smelting works are found together, the copper-smelters look somewhat enviously at the alkali-makers.

Before the passing of the Alkali Act, the farmers who thought they had suffered loss through the injury of their crops by acid-vapours charged the damage sometimes against the alkali-works and sometimes against the copper-works. Now, however, owing to the improvements which have been made in the alkali-works under the stimulus of the Act, and supposing the manufacturers to be somewhat protected by it, the landholders direct their attacks exclusively against the copper-smelters. The amounts claimed by each farmer are not always large, but the aggregate has reached £3000 a-year against the six copper-works.

Besides these smaller claims, an important action was lately brought, by the proprietor of an estate three miles from St. Helen's, against a copper-smelter, for damage done to his trees and crops by the smoke from the works. The course the action took so well shows the present working of the law, and indicates, perhaps, the direction in which it could be amended, that it might be well to give some account of it here.

The plaintiff proved he had received damage from smoke coming from the direction of the defendant's works, and alleged that the damage he had sustained was wholly done by them, intimating that if he gained a verdict in the present suit he should apply to the Court of Chancery for an injunction to restrain the carrying on of the works altogether, as, he believed, he would then be free from all damage. In defence, it was pointed out that the defendant's works lay in a straight line between the plaintiff's land and St. Helen's, so that the same wind which brought defendant's smoke would also convey the smoke from a large portion of St. Helens; and that, in general, as the plaintiff's park was subject to injury from all the factories in the neighbourhood, it was unjust to charge the whole damage upon the defendant.

It will be seen that the following question would at once present itself:—Is it possible to determine the amount of damage which each factory in a district contributes towards the damage done by all?

In other words, if a farmer sustains a loss of £100 through his crops being injured by the accumulated smoke of a manufacturing district, is it possible to set down to each manufacturer the amount which he ought to contribute towards this £100?

Turning to the fifth of Dr. R. Angus Smith's very able reports under the Alkali Act, we find this question anticipated, and an answer given. Referring to the amount of acid-vapours thrown up with the smoke of factory-chimneys, he says, at page 25:—Now it is easy to estimate this amount; and it is easy to put down to everyone in the district the exact share of guilt, so far as the acid is concerned. . . . Perhaps we may also bring in the element of distance."

In consequence of this, Mr. Alfred E. Fletcher, the Inspector under the Alkali Act for the district which includes West Lancashire, was asked to apply himself to the question. He had to consider—

1. The distance of each factory from the injured land.
2. The rate at which the increase of distance diminishes the power of the smoke to do damage.
3. The number of days throughout the year on which the wind blows from each point of the compass.
4. The amount of acid-vapour discharged from each factory in a given time.

First, the distances; these are easily measured on the map.

Information on the second point was obtained in the following manner:—At a time when the ground was covered with snow for a week, lines were drawn, in a direction following the wind, from St. Helens, and from other groups of works, to a distance of two or three miles. At each half-mile a sample of the surface-snow was collected, and brought home for analysis. Also, during a period of rain, collecting vessels were set at regulated distances from a group of works. A determination was then made of the amounts of muriatic and of sulphuric acids collected by the snow and by the rain, and these were compared with the distances at which the samples had been obtained. It was seen that the amounts diminished in even ratio with the increase of distance. Probably a sufficient number of experiments of this nature have not yet been made firmly to establish the law; for the undulations of the ground, the position of trees, and any objects which interfere with the uniform motion of the air, affect the even deposition of the acid-vapours. More experiments, it was said, were about to be undertaken, in order to establish the law on a wider basis. Information on the third point may be usually obtained at some neighbouring observatory. In



the case of St. Helens, the returns of the direction of the wind published at the Liverpool Observatory, on Bidston Hill, were depended on.

Fourthly, the amount of acid-vapour discharged from each factory in a given time can be known by periodical examination of the gases which are passing up the various chimneys of the works. This is already done, as far as the alkali-works are concerned, under the provisions of the Alkali Act. In the cases of copper-smelting works, glass-works, and others where systematic inspection has not been carried on, the amounts of acid-vapour thrown into the air can be calculated from the materials used in the manufacturing processes carried on.

The acid-vapours discharged from the various works in the St. Helens district are:—From ten alkali-works—muriatic acid, sulphuric acid, sulphurous acid, nitrous acid, chlorine, coal-smoke; from nine glass-works—muriatic acid, sulphuric acid, sulphurous acid, vapour of common salt, coal-smoke; from six copper-smelting works—sulphuric acid, sulphurous acid, coal-smoke; from six collieries, six iron-foundries, two soap-works, eight thousand dwelling-houses—coal-smoke; from the Sankey Brook and the heaps of alkali-waste—sulphide of hydrogen.

This is a formidable list; but the amounts of each may be calculated with a very near approach to accuracy, except the last item, the sulphide of hydrogen, which varies continually with the amount of rain-fall, and with the temperature of the air.

Having, then, collected the information as set forth under these four heads, it became merely a question of figures to apply it to the solution of the problem raised in the St. Helens law-suit. A list was made out of the principal factories in the district capable of doing injury to the plaintiff's land. Opposite these was set down the distance of each factory from the land, and, in a parallel column, the amount of acid-vapour thrown up by each. On dividing the figures in the second column by those in the first, numbers were obtained which were proportioned to the share each one had contributed to the total damage done by all to the plaintiff's land.

Further, a method was adopted by Professor Roscoe, of Owen's College, Manchester, which confirmed the accuracy of this calculation.

St. Helens lies, as has been said, three miles from the plaintiff's park, defendant's works being half-way between them.

While the snow lay on the ground last February, the wind blew mainly from the east. Professor Roscoe then took samples of the snow lying three miles west of St. Helens, and also some of that lying a mile and a half west of defendant's works, that is, the same distance to the west as plaintiff's land is to the south-south-east. He found that the proportion of the amount of acid contained in the one to that contained in the other agreed closely with the proportion determined by Mr. Fletcher in the previous calculation. This was given as evidence at the trial; and it appears that the jury acted on the principle here laid down, that a manufacturer should only be called on to pay in proportion to the amount he contributes to the total damage sustained, and that it is possible to ascertain what that amount should be. Since this trial, two other similar cases have been decided by arbitration: in each of them the arbitrator showed, by his award, that he adopted the principles here set forth.

Having now given some account of the working of the Alkali Act, the most recent legislation on the difficult subject of air-pollution, and sketched the action of the law courts when matters of the kind are brought before them, it may be desirable to discuss the course which further legislation should take in the matter.

As regards the present Alkali Act, we would object that, though successful, it is too limited in its application.

Secondly, the onus of carrying out its penal clauses rests on the inspector. We should have a noxious-vapour Act, applicable to every manufacture where injurious gases are thrown off. The duty of the inspector should be

solely to inspect, and to publish the results of his inspection: the public should be the prosecutors.

Let us follow the working of such an Act. In every district, its inspector would from time to time publish a list of the works, together with the amounts of acid or other vapour escaping from them; this would be given either as the amount in 1000 cubic feet of the chimney-gases, or the actual amount by weight of that which escapes per month or per annum. The result of this to the manufacturers would be that they would anxiously consult the published list, and exercise a wholesome rivalry as to who should stand well in it. Moreover, these lists would form the basis for assessment of damages in case of claims made by the neighbouring farmers. A pecuniary stimulus would thus also be given. To the neighbouring farmer or landholder these lists would be invaluable; they would show him where to apply with the best chance of success for compensation for proved loss by noxious vapours, or enable him to apportion his claim among several works, in proportion to their places in the list and their relative distance from his land.

Thus, in place of the goading influence of a few isolated and sudden prosecutions, a gradual pressure onwards would be felt—a constant stimulus to improvement. All chemical manufacturers cannot be embraced in the provisions of an extended Alkali Act until for each separate noxious vapour a process of suppression can be described, and a limit for its working defined; but, with such an arrangement as is here proposed, all noxious vapours, without the task of enumeration, would be at once legislated for. If there are several manufacturers carrying on the same processes in the same district, and one of them, by special ingenuity, discovers some process by which a large portion of the acid-vapour he has hitherto sent away may be condensed, he improves his place in the list, and so enjoys immunity from actions for damage on the part of the farmers. The other manufacturers would obviously be compelled to follow him in the race of improvement. Thus all would be brought up to the rank of the foremost, and there would be a constant impulse to the manufacturer to reduce the noxious emanations from his works within the smallest possible amount.—*Quarterly Journal of Science*.

#### CHEMICAL TABLES ACCORDING TO THE THEORIES OF MODERN CHEMISTRY.\*

By Prof. ALBERT R. LEEDS.

So long as chemistry was in a transition state between the theory of dualistic combination, the electro-chemical theory of Berzelius and his disciples (which reigned with an almost absolute sway during the first half of the present century), and the unitary theory evolved by Gerhardt, Laurent, Dumas, Hofmann, and other illustrious theorists, chemists might reasonably bear with patience the contradictions and perplexities arising from the unsettled condition of the science. In the opposing rush of contending opinions, the old and well-known landmarks had been swept away, the high-roads of thought had been blocked up by the wrecks of abandoned theories, and little else except the original soil—the facts themselves—remained, upon which the theories of modern chemistry might enter and take undisputed possession. The few who cling to their ancient beliefs have ceased to defend them, and only plead the inaptitude of old age, or the bias of early education, in defence of their loyalty.

But, now that the unitary theory has prevailed, it is intolerable that we should be compelled to reason upon and perform the operations of a chemical synthesis or analysis by the formulæ of the old, and compute its numerical results by the data of the new system. Still more so, that

\* Communicated by Professor Morton. From advance-sheet of the *Journal of the Franklin Institute*.



we should calculate values for constituents, the bare existence of which has never been demonstrated. As, for example, that we should calculate, from the results of an analysis of felspar, its percentage of potash, soda, lime, magnesia, iron, and silica, when it has not been proven that any of these compounds exist as such in the felspar. To evaluate the potassium, sodium, calcium, magnesium, aluminum, iron, and silicon radicals, and then add the oxygen, sufficient to close the atomic group, is all that our present knowledge admits of.

To obviate these difficulties, the table given at the end of the present memoir was all that was originally conceived of. It was designed to give, in this table, the formulæ and molecular weights of the most important substances, and to adapt it to the ordinary calculus of synthetic and analytical chemistry. But when it became necessary, as a preliminary step in the construction of such a table, to select values for the atomic weights of the elements, a source of great perplexity presented itself. The values given in the most important general works upon chemistry were found, as will be seen by reference to Table II., to exhibit considerable discrepancies, and to differ, not only between wide limits, but also without apparent rule. There was no shorter way of solving these difficulties than to examine the sources from which these numbers for the atomic weights were originally drawn. This has been an arduous task, and has carried me far beyond the scope of the first intention. But the pleasure and instruction derived from the critical study of the classic literature of the subject, has more than repaid the outlay of time and labour.

First in order and importance is the chapter on the "Bestimmung der Atomgewichte der Grundstoffe," which is given by Berzelius in the third volume of the Leipsic edition of his "Lehrbuch der Chemie." His wonderful analytical skill, fertility of invention, close discrimination, and impartial judgment, inspire the chemist with grateful admiration for his great master. The numbers given by Berzelius are taken on the oxygen scale,  $O=100$ . In the table of atomic weights, according to the original observers, I have computed from these numbers their corresponding values on the hydrogen scale, hydrogen being taken as 6.24, the number assigned to it by Berzelius. But in Table III., which I have adopted as a standard, the value of the hydrogen unit on the oxygen scale has been taken as 6.25, in accordance with Dumas; hence, when the atomic weights of Berzelius have been retained, their values have been re-calculated, on the supposition that the hydrogen unit taken on the oxygen scale is 6.25. This will explain the apparent discrepancies between Tables I. and III. Next in importance to the labours of Berzelius were those of Dumas, which will be found in the *Ann. de Chem.* [3], i., 5; viii., 189; and iv., 129. They were undertaken with the purpose of establishing the truth of Prout's law—that the atomic weights of all the elements are multiples by some whole number of that of hydrogen. The numbers which Dumas obtained compelled him to abandon the law of Prout as originally maintained, and induced him to promulgate it again in a modified form. He brought forward the theory that the elements might be divided into three groups; in the first of which he placed those elements whose atomic weights are multiples of the atomic weights of hydrogen; in the second, those whose atomic weights are multiples of 0.5, the atomic weight of hydrogen; in the third, those whose atomic weights are multiples of 0.25, the atomic weight of hydrogen. But, even then, some deviations from the experimental data was requisite to accommodate his observed to his theoretical atomic weights.

Later, a series of researches was undertaken by Stas, and published under the title of "Recherches sur les Rapports Reciproques des Poids Atomiques," in the *Bull. de l'Acad. R. de Belgique* [2], x. (No. 8), 1860. He re-determined the atomic weights of oxygen, chlorine, sulphur, potassium, sodium, silver, and lead with exceeding care, and exhausted the refinements of chemical art in the purification of his

reagents, the variation of his methods, the accuracy of his weighings, and the verification of his results. The differences between the numbers attained by Stas, in a great number of trials for the atomic weight of each of the above-mentioned elements, is less than the differences between the observed atomic weight and the atomic weight which would be required to bring it into conformity with Prout's law. Stas naturally maintained that the atomic weights which he had obtained by unimpeachable experiments should be adopted in opposition to those supported only by theory. It has been said, in reply, that we must not expect to find in chemistry, any more than in botany and zoology, a law of proportion between parts verified in Nature with mathematical exactness, but only a more or less close approximation—a view certainly of great plausibility, and fortified by abundant analogy. At this point the discussion, for lack of proof more decisive on either side, at present rests.

(To be continued).

## ON THE ANILINE OR COAL-TAR COLOURS.\*

By W. H. PERKIN, F.R.S.

(Continued from p. 33).

### *Mauve, Magenta, and some of their Derivatives.*

You will remember that in my last lecture we went over all the various steps between coal and colour. We saw how coal-tar was produced from coal; how coal-tar, naphtha, and benzol were separated from coal-tar; how nitrobenzol and aniline were made from benzol, and concluded with an account of the preparation of aniline purple, or mauve from aniline. We will now proceed to the study of some of the most remarkable properties of aniline purple.

This colouring matter is sometimes supplied to consumers in a pure and beautifully crystalline condition. This product is found to be a salt of a compound, chemically termed an organic base. This base has been called "mauveine;" it is composed exclusively of carbon, hydrogen, and nitrogen, in the following proportions:—



Mauveine, although the base of aniline purple, when in solution is not of a purple but of a dull violet shade, and in the solid state is a nearly black crystalline powder. The moment, however, mauveine is brought in contact with an acid so as to form a salt, its solution changes to a purple colour. This takes place even with that feeble acid carbonic. I have here a dilute solution of mauveine; you will observe the dull violet colour it possesses, but if my assistant only breathes through it a few moments the carbonic acid of his breath will combine with it, and it will acquire the ordinary colour of aniline purple.

Mauveine is a most powerful chemical body, and will easily decompose ammoniacal salts. This may be readily seen if some mauveine be heated with chloride of ammonium and a little water, when an abundance of ammonia gas will be evolved, which can be distinguished not only by its odour, but by the white fumes it produces with hydrochloric acid.

The salts of mauveine are beautifully crystalline, and possess a splendid green metallic lustre. The crystallised commercial product consists of the acetate. Mauveine possesses one of the peculiar properties of indigo. Indigo, when treated with reducing agents, such as a mixture of sulphate of iron and lime, is rendered nearly colourless and soluble, but this colourless indigo, when subjected to the oxidising influence of the atmosphere, rapidly becomes blue again. I here refer to the indigo vat so much used by dyers. Mauveine, when treated in a similar manner,

\* The Cantor lectures, delivered before the Society of Arts.



is also nearly decolourised, changing to a pale brownish yellow fluid, but the moment this is exposed to the air it assumes its original colour far more quickly than indigo. This remarkable fact may be strikingly illustrated by boiling an alcoholic solution of salt of mauveine with a few strips of zinc in a sealed tube from which the air has been previously removed. The dark purple solution will gradually lose its colour, and change to a very pale-yellowish brown shade.

I have a tube containing some aniline purple decolourised in this manner, and now if I open it, the air rushes in and the solution instantly assumes the ordinary purple colour.

Ordinary indigo is quite insoluble in water, and, therefore, its property of becoming soluble, as well as colourless, when treated with reducing agents, is of great practical value, as the dyer, by immersing his goods in this solution of indigo, and then exposing them to the oxidising influence of the air, gets the colouring matter firmly fixed in the fibre of his materials. But as the mauve is always soluble in water, this property has not been found of any practical value.

Aniline purple, when introduced as a dye, being the first colour of its kind, had to encounter many prejudices, and, on account of its peculiar nature, required the adoption of new or modified processes for its application. These difficulties, however, once overcome, its progress was very rapid. At first it was principally employed by the silk dyer and printer, its application to silk being comparatively easy, but it was not used by the calico-printer till a few years afterwards.

I distinctly remember, the first time I induced a calico-printer to make trials of this colour, that the only report I obtained was that it was too dear, and it was not until nearly two years afterwards, when French printers put aniline purple into their patterns, that it began to interest British printers.

It will be seen that to introduce a new coal-tar colour after the mauve was a comparatively simple matter. The difficulty in the manufacture of all the raw materials had been overcome, as well as the obstacles in the way of the practical applications of an aniline colour to the arts.

We will now turn our attention to a colouring matter which has often been confounded with aniline purple. I have designated it as "Runge's blue," as it was first observed by Runge. I have mentioned that Runge, when he first obtained aniline, termed it "kyanol," or blue oil, on account of the blue-coloured solution it gave with chloride of lime.

After discovering the mauve, I naturally made experiments with this coloured product of Runge's, to see if it contained aniline purple, but my experiments answered the inquiry in the negative. A few years afterwards, however, I was puzzled by finding that French manufacturers were beginning to produce aniline purple by the agency of chloride of lime and a salt of aniline; being much occupied at that time, I was unable to look carefully into the matter; and it was not until investigating these apparently opposite results a short time since that I was able to understand them. I will perform Runge's experiments, and for that purpose will take a solution of hydrochlorate of aniline, and add to it a very dilute solution of chloride of lime (taking care not to add too much). The solution is now changing, and getting slightly opaque; by daylight it has an appearance like indigo, but if I render it clear by the addition of alcohol, and place it before the magnesium lamp, it is seen to be of a brilliant colour, and nearly pure blue, quite unlike aniline purple.

I have lately succeeded in obtaining this blue product in the solid condition by treating a solution of hydrochlorate of aniline with a dilute solution of chloride of lime, and precipitating the resulting colouring matter with common salt; it is thus obtained in an impure condition, and may be collected upon a filter; by treatment with cold ether or benzol, a large quantity of brown impurities are separated, the colouring matter being left in the solid

condition. This substance dissolves in alcohol, forming a nearly pure blue solution, and is capable of dyeing silk a blue or blue-violet colour.

An alcoholic solution of Runge's blue behaves with caustic potash quite differently to aniline purple, forming a brownish-red coloured solution instead of a violet. Therefore, there can no longer be any reason for confounding this body with aniline purple, it being entirely different, both in colour and chemical properties. But as this colouring matter is produced by oxidising hydrochlorate of aniline with chloride of lime, how is it that manufacturers have succeeded in preparing aniline purple with the same reagents? This question I find is very easy to answer: the manufacturer has gone a step further and boiled his product. Now, if I take a piece of silk dyed with Runge's blue, and, instead of boiling it, which would wet it, and make it difficult to manipulate, do that which is equivalent—steam it—a very remarkable change takes place—Runge's blue being changed into the mauve. So, here we have cleared up the mystery, and find that by the action of chloride of lime on hydrochlorate of aniline, we first get Runge's blue, and then, by heating this blue we change it into mauve. Runge's blue is a very unstable body, and of no practical value, its alcoholic solution changing into mauve in a day or two. This change takes place directly by boiling.

We must now pass on to another colouring matter, in name well-known to all of you, I mean magenta, also called roseine, fuchsine, aniline red, and various other names. The discovery of this body and its manufacture were strangely dependent upon the source which had been selected for the preparation of aniline for the mauve. Had the aniline contained in coal-tar, or the aniline obtained from indigo, been employed for the preparation of the mauve, instead of that prepared from commercial benzol, magenta and its train of coloured derivatives would, in all probability, have remained unknown to this present day, from the simple fact that magenta cannot be produced from pure aniline, a second body being also required.

You will observe, by reference to the table of coal-tar products, that next to benzol there is a substance named toluol, a substance having a boiling point not very much above that of benzol. On this account toluol is always contained in commercial benzol, and possesses most of its properties. With nitric acid it forms nitrotoluol, very similar to nitrobenzol; with iron and acetic acid it is converted into a base, toluidine, very similar to aniline, except that it is solid instead of liquid, when pure. Therefore, aniline prepared from commercial benzol always contains a little toluidine, and this is the second body requisite for the formation of magenta.

An apparatus for the fractional distillation of coal-tar naphtha has been devised, so that its constituents may be almost completely separated from each other, and thus pure benzol or pure toluol may be obtained.\* Having obtained these hydrocarbons, pure aniline and pure toluidine may be prepared and then mixed in the most suitable proportions for manufacturing magenta. This process is not very generally employed, however, but the quality of the mixture of aniline and toluidine is determined by distillation, noting the quantities which come over at different temperatures. The necessity of toluidine as well as aniline for the production of magenta was discovered by Dr. Hofmann, who found that it could not be produced by perfectly pure aniline, nor perfectly pure toluidine, but that a mixture of these two bases yielded it in quantity. Magenta was apparently first observed by Natanson, in 1856, when examining the action of chloride of ethylene on aniline, and afterwards by Dr. Hofmann, in 1858, when studying the action of tetrachloride of carbon on aniline, but industrially the discovery of magenta was made by M. Virguin, of Lyons, in 1859, three years after the mauve. M. Virguin's process con-

\* See "Clarke's Specification," June 5th, 1863, No. 1405.

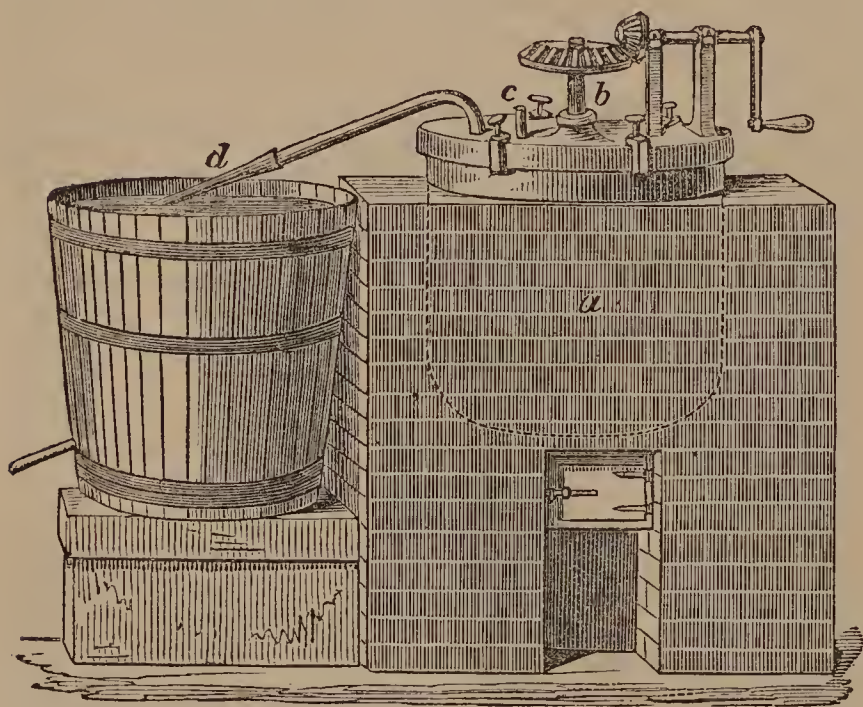


sisted in treating commercial aniline with a fuming liquid, called tetrachloride of tin, and was first carried out by Messrs. Renard Brothers, of Lyons. Since 1859, patents have been taken out for the production of this colouring matter with aniline, and almost all chemicals known, whether capable or incapable of forming magenta. I may mention one process which was extensively employed, and is still used to some extent in Germany, and that is the method of making magenta with commercial aniline and nitrate of mercury. With care this process works very well, and the colouring matter produced is of good quality. When first introduced, magenta prepared by this method was not purified, but sent into the market in a crude form, so that before using it the dyer had to extract it with water. In the preparation of magenta by this process, all the mercury of the nitrate of mercury employed is recovered in the metallic state, but although this process may possess some advantages, yet the use of mercury salts is most undesirable on account of their fearfully deleterious influence upon the workmen.

The process, which has almost superseded all others, is that for the use of arsenic acid, as proposed by Medlock, and patented by him in January, 1860. This patent is notorious for the amount of litigation it has caused, showing that a patentee should not only be a discoverer but a lawyer, and even more, and able to discover precisely how much to claim and disclaim in his patent, and also to arrange his specification so that the intellects of the whole world may not be able to discover a single flaw in his description; and it is a common misfortune to inventors who wish to thoroughly protect themselves to find that they have claimed too much.

The manufacture of magenta, as now carried on, is a very simple process; it is conducted in an apparatus somewhat similar to that represented by fig. 5.

FIG. 5.



This apparatus consists of a large iron pot, *a*, about 4 ft. diameter, set in a furnace of brick-work; it is provided with a stirrer, *b*, worked by hand. All the gearing for this stirrer is fixed to the lid, so that stirrer, lid, and all may be lifted away by means of a crane or other suitable apparatus. There is also a bent tube fixed into the lid, and connected to a condensing worm, *d*, by means of a joint, which can be made or broken at pleasure. In preparing magenta, a quantity of aniline, containing about 25 per cent of toluidine, and a nearly-saturated solution of arsenic acid, is introduced into this apparatus, and well mixed by working the stirrer; the proportions of the materials are in about the ratio of 1 of aniline to 1.5 of a 75 per cent solution of arsenic acid. When these are well mixed the fire is lighted. After the product has been heated for some time water begins to distil over, then aniline and water, and lastly nearly pure aniline.

This operation requires some hours for completion, and this is determined by inserting an iron rod, from time to time, and drawing out a portion of the product for examination, as well as by the amount of aniline which distils over. When the heating has been completed, a steam-pipe is introduced into the apparatus, and steam blown through the fused mass; by this means an additional quantity of aniline is separated. The lid is then liberated and lifted, with the stirrer, from the apparatus, and the product left to cool before it is removed. A more elaborate and larger apparatus is sometimes used, which possesses considerable advantages over the smaller one. The iron pot is larger, and is provided with an outlet at the side, which is closed during the operation, and the shaft of the stirrer is hollow (as in the aniline apparatus described last lecture, fig. 4), and worked by steam. When the operation of heating is concluded, steam is blown down the shaft, and after the addition of water the product is boiled and run out of the outlet in the side of the pot; by this arrangement it is unnecessary to disconnect the lid of the apparatus, and the product does not require to be removed by mechanical means, as with the apparatus previously described.

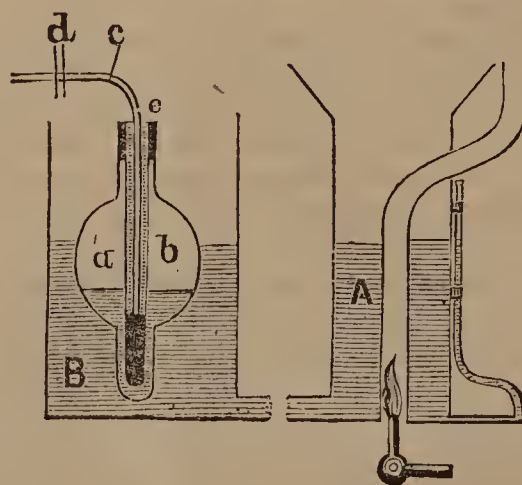
The crude product obtained by heating aniline and arsenic acid, is next transferred to vats, boiled with water, and filtered. Common salt is then added, which precipitates the crude magenta; this is collected and dissolved in boiling water, again filtered, and the solution, on cooling, deposits the colouring matter in the crystalline condition. This, when re-crystallised, constitutes commercial magenta.

(To be continued.)

#### ON A CONTINUOUS WATER-BATH.\*

AN apparatus of this kind, fully meeting all demands upon it, was some time since designed by Prof. Bunsen, who has abundantly stocked his laboratory with these, now, indispensables, which are only excelled for convenience and in saving of time and labour by the well-known filtering-pump. The want of just such a contrivance as this will have been felt by every chemist.

The method he adopts is to maintain a constant water level in a reservoir, which has free communication with one or with any number of the baths. In the accompanying



cut, *A* is the bath in cross section, composed of an outer copper cylinder, through the centre of which runs a small tube of the same material, emerging at the upper end of the cylinder beneath a large flue. In the lower part of the cylinder an ordinary burner is permanently fixed, which heats the bath, and the products of its combustion are thus safely carried off. The upper part of the cylinder is fitted to receive a large funnel, in which the capsules, &c., of various sizes, containing the material to be evaporated are placed, the watery vapour escaping likewise

\* Communicated by Dr. W. H. Wahl. From advance sheets of the *Journal of the Franklin Institute*.



under the flue. The lower end of the cylinder is furnished with an outlet upon each side,—one connecting with an open glass tube attached to its side, to indicate the level of the water within, and the other connecting with the reservoir, B.

This, the essential portion of the contrivance (shown in cross section in cut), consists of an outer glass vessel, B, containing water, in which floats the bulbed tube, *a*; within this again stands a tube, *b*, open above like *a*, and containing some mercury. A tightly fitting caoutchouc ring, between the two, holds *b* in its place, and prevents any communication with *a*; and lastly, within *b* is a small tube, *c*, connecting with the water main, and dipping somewhat into the mercury of tube *b*. The tube *c* is held immovable in its place by clamps indicated at *d*, and does not partake of the up-and-down motion of the tubes *a* and *b*, about to be mentioned.

The various parts having now been given in detail, it only remains to consider their operation.

The water in A and B, being in communicating vessels, is at the same level in both; but the instant the flame lowers the level in A, by vapourising its contents, it is restored by the influx of water from B. The loss of water in B would leave less to buoy up the float, which consequently sinks. In the sinking of the float, however, the opening of the tube *c*, (which is immovable), is left under the pressure of a smaller column of mercury, and when the sinking has reached a certain point, the pressure of water from the main becomes greater than the opposing pressure of the mercury. Water flows from it, bubbles through the metal, fills the tube *b*, and overflows at *e* into the reservoir B. The increase of water in this gives increased buoyancy to the float; it rises, the opening of the tube *c* is plunged deeper into the mercury, the increasing pressure of which prevents further flow from the water main. The original level has now been regained, and equilibrium restored; but only to be destroyed again, by the continued action of the lamp, vapourising the water in A, which brings about the indefinite repetition of the process just described in detail.

The height to which it is desired that the water, in the bath shall stand, can be regulated in various ways; either by loosening the clamps at *d*, and closing them again, after giving to the opening of tube *c* a permanently higher or lower position than it had previously occupied, or by adding to or taking from the mercury in *b*, &c.

It need scarcely be stated that one reservoir can be connected with quite a number of baths, by carrying a water-pipe behind them and allowing a separate tube to lead to each bath. This contrivance is, as its name indicates, entirely automatic. Material can be left upon it over night; or for days together, without requiring the constant attention, replenishing of water, &c., which make the use of the old, time-honoured instrument so often troublesome and delaying.

## NOTICES OF BOOKS.

*The Manual of Colours and Dye Wares: their Properties, Applications, Valuation, Impurities, and Sophistications.* For the use of Dyers, Printers, Drysalters, Brokers, &c. By J. W. SLATER, Author of "The Handbook of Chemical Analysis for Practical Men." London: Lockwood and Co. 217 pp.

THE author of this little volume states that the object of this manual is to furnish, in a brief space, an account of the chemical products and natural wares used in dyeing, printing, and the accessory arts—their properties, their applications, the means of ascertaining their respective values, and of detecting the impurities which may be present.

We have, therefore, a book professing to give accurate

information upon the subjects the author treats of, in alphabetical order, beginning with acetate of iron (so-called black liquor, or pyrolignite of iron), and ending with sulphate of zinc. It is perfectly clear that it is quite impossible to review *seriatim* each, or even many, of the articles contained in this work; but, in order to judge of its contents fairly and in an unbiassed manner, we shall, at random, take some instances, in order to see how far the author has succeeded in his plans.

At page 41, we read—"Carmines.—The finest portion of the colouring matters of cochineal, freed, as far as possible, from impurities, and combined with alumina." Perfectly pure carmine is readily soluble in ammonia, and does not contain alumina at all. The author forgets that the alum used in the preparation of carmine from cochineal serves no other purpose than that of hastening the settling down of the colouring matter, "carmine," which is *not combined*, as comparatively recent researches have taught, with alumina, and does not contain a trace even of that base. The compound of the colouring matter of cochineal with alumina is known as carmine lake. Of "Chinese Green" (*Lo-kao*), we read (page 44)—"A simple green colour, whose nature and origin are still involved in obscurity." The author should have taken more care to study this matter. The nature and origin of this substance are known accurately; but, from the host of information on this subject, which alone would fill more than two numbers of our paper, we need only state here that it is the product of the *Rhamnus utilis*, called, in Chinese language, *hong-pi-lo-chow*; and not only is the preparation of the *lo-kao* well known, but it is even extracted from European plants of the *Rhamnus* tribe. Speaking of "Madder" (page 107), the author says—"The Dutch and Alsatian madders, which are in great request for certain shades, but which do not equal the Avignon qualities, are"—&c. Now this peremptory statement that these madders do not equal the Avignon qualities, is directly at variance with the experience of all those who employ these substances on the large scale, and are well acquainted with their properties, degree of maturity, and proper mode of application; we can, moreover, say that a large number of sound, practical men, in France, regret that, in order to favour the Avignon and *Palud* (not *Palus*, as written by the author) growers of madder-root, the use of Zeeland madder is almost prohibited there. Regarding this, no less an authority than M. Girardin (whose views in this respect were fully endorsed by the late celebrated Mr. Walter Crum) says that, when applied at its maximum of maturity, Zeeland madder is, in every respect, superior to all others, and the Alsatian is not much behind it. Speaking of "Persian berries," the author says (page 142)—"Some of the berries are large and greenish, whilst others are smaller, brown and wrinkled, the colouring principles in these two kinds being distinct." There are met with in commerce no less than seven different kinds of these berries, the produce of different countries, as well as of different varieties of the same tribe of shrubs; but it is not correct to say that the colouring principles differ according to the varieties of the berries. The coloured glucosides contained in these berries do not vary, unless the berries are too old and turning black, when the colouring principles have undergone an alteration, as has been proved by the labours of MM. Persoz, Gellatly, Ortlieb, Schützenberger, and Bertèche. The statement, therefore, that, as regards the berries, the colour of the large or greenish should be known as *rhamnein* or chrysorhamnine is not correct, the author evidently having neglected to consult the papers of the gentlemen just named on this subject. Of "Safflower," it is stated (at page 152) that it contains *two* colouring matters—a yellow, which is worthless, and a red, which is very fine; it is also said (page 153) that the yellow matter is soluble in cold water. The fact is that safflower contains three colouring matters—viz., one yellow, soluble in pure and acidulated water; another yellow matter, only soluble in an alkaline liquid; and,



lastly, the red colouring matter, called carthamic acid or carthamine.

We need not multiply such instances; a thorough and unprejudiced perusal of this book shows it has been written without sufficient care, and without the use of such books as the author speaks of in a somewhat contemptuous tone in his preface. The work certainly contains some good matter, but the whole *ensemble* has been evidently hurriedly compiled and is very ill digested. Such a work might be made to convey precise and correct information; but the present volume, we regret to say, does not do this. As to the purely chemical part, we abstain, purposely, from saying more than this—that the existence of really good books treating on qualitative, as well as quantitative, chemical analysis, renders superfluous what the author has published in these pages. The typographical execution of the book is good, and its index very complete.

*Report on the Gas Nuisance in New York.* By C. F. CHANDLER, Ph.D., Professor of Analytical and Applied Chemistry, School of Mines, Columbia College. Extract from the Fourth Annual Report of the Metropolitan (viz., Empire City, New York) Board of Health. New York: D. Appleton and Co. 1870.

WE are indebted to Dr. Chandler for having forwarded a copy of this very interesting and elaborate report.

The nuisance, known as gas nuisance, which for a considerable period of time must have been intolerable to those districts of the City of New York situated near the localities from which it arose, is described by the author as having been caused by the exposure to air of the foul lime used in the so-called dry lime process of gas-purification by some of gas companies which supply the illuminating-gas to the city alluded to; and, in the report before us, the Metropolitan Company is the chief delinquent. This company, it appears, did not take the least heed of the complaints made; and, as a consequence, the Metropolitan (New York) Board of Health took vigorous steps to enforce the order made by it, whereby all the gas companies of the said city were compelled so to conduct their operations as to prevent injury to life and health. The Metropolitan Gas Company, instead of complying, commenced a litigation with the Board; and, as a consequence, there was commenced, before magistrates, an inquiry into the whole affair, and witnesses were heard on oath, and the whole question of gas-purification thoroughly gone into. Among the well-known scientific gentlemen summoned to appear and give evidence were—Dr. Chandler, as chemist to the Board of Health before referred to; Prof. B. Silliman, for the Gas Company; Prof. Wurtz, for the same. Prof. Silliman differed in opinion from Dr. Chandler as to the expediency of introducing the so-called iron purification-process, instead of lime; but he stated clearly and unequivocally that the process of purification as conducted by the Metropolitan Company was a nuisance which, by using simple precautions, could be avoided. After a great deal of delay, and the making of excuses of all kinds, the gas company referred to (having spent, in expert fees, counsel fees, &c., some 10,000 dollars) have complied with the order of the Board of Health, and introduced a system of purification which answers the purpose.

The Report before us (about 112 pages in small type, chiefly containing the full evidence given before the Court at New York) contains, as may be imagined, a very large amount of valuable scientific and practical matter relating to the purification of gas and gas manufacture in general; while the very compact and ably-written paper on the methods of gas-purification from Dr. Chandler's pen greatly contributes to make this work an excellent *exposé* of the subject treated of, as carried out in practice.

## CORRESPONDENCE.

### THE SPECTROSCOPE APPLIED TO THE BESSEMER PROCESS.

*To the Editor of the Chemical News.*

SIR,—In the third volume of Crookes and Röhrig's "Metallurgy" (which has just come into my hands), I find, on page 721, that, although the authors give me the credit of first proposing (in 1863) to use the spectroscope in the Bessemer process, they state that the actual practical application is due to Professor Lielegg, in 1868.

As it seems to me, the merit of the practical application is rather due to the Styrian iron and steel makers, who adopted, as valuable, the results of Lielegg's experiments—results which are, in fact, identical with those which I made known five years before. I then showed, beyond doubt, that the exact point of decarbonisation can be accurately arrived at by spectrum observations; and I frequently ascertained that this point exactly agreed with that at which the blast is turned off. The English steel-makers were shown in 1863 exactly that which the Styrian makers were taught in 1868. The English appear to think that the point can be detected by the naked eye with a sufficient degree of exactitude; the Styrians prefer to use the spectroscope.—I am, &c.,

HENRY E. ROSCOE.

Owen's College,  
Manchester, July 13th, 1870.

### ABRIDGMENTS OF SPECIFICATIONS RELATING TO AERONAUTICS.

*To the Editor of the Chemical News.*

SIR,—As compiler of the "Abridgments of Specifications relating to Aëronautics," I have to express my best thanks for the very favourable critique upon that little work that appeared in the CHEMICAL NEWS (vol. xxii., p. 19).

As the gentlemen that are deputed by the Commissioners of Patents to compile certain series of Abridgments are extraneous to the Patent Office, as they are chosen for their special knowledge of the subjects they undertake, and as their names are annually published in the Commissioners' Report, I was surprised that no recognition of my connection with that work appeared in your notice. I may perhaps be allowed to remark that the publication of the name of an abridger is possibly an act of justice to the public, as well as to himself. I therefore would suggest that you state my connection with that work, and with the introduction thereto, in any way that you may think best.—I am, &c.,

W. H. WALENN.

74, Brecknock Road, N.  
July 13th, 1870.

[The compiler's name having only been given to us in writing, we did not feel at liberty to publish it when reviewing the work.—Ed. C. N.]

### RUBIDIUM AND CÆSIUM.

*To the Editor of the Chemical News.*

SIR,—I have found that, so far as my researches on rubidium and cæsium in sea-water and its products depend upon spectroscopic reactions, they are unreliable. In seaweed, as stated, I have found, by analytical methods, these alkalies; and, so far, the work can receive no further confirmation than it has already had. But, as respects the oxalate of calcium thrown down from sea-water, and the spectroscopic reactions of sea-shells and of limestone, I now believe the lines attributed to rubidium and cæsium



to be due to calcium and to strontium respectively. It is curious, and may, perhaps, partly excuse me, that the trace of strontium, at the most, that can be supposed to be contained in sea-water and in shells should, when so combined, give *only* the line belonging to strontium marked *delta* in the maps, and therefore the fourth in order of intensity; but my further experiments leave me no room to doubt but it is so. This line, in my instrument, is not distinguishable from the blue line given by an impure compound of caesium, no more than is the blue calcium line from the most characteristic of the rubidium lines. So far as I trusted to the spectroscope alone, so far I was deceived; but what was done independently of the spectroscope remains true.—I am, &c.,

E. SONSTADT.

Ramsey, Isle of Man,  
July 18th, 1870.

#### MR. BESWICK AND SWEDENBORG.

*To the Editor of the Chemical News.*

SIR,—Mr. Beswick leads us to a mare's nest. That a certain quantity of dry salt disappears in water without increasing the bulk of the liquid is a very ancient observation. How could a fact at once so curious and obvious escape even a housewife's eye? The familiar anecdote will be remembered of King Charles II. testing the wits of a party of philosophers by requiring of them the reason why a fish immersed in a bucket full of water did not cause the water to overflow. Forthwith, several began to devise explanations, until one, shrewder than his fellows, suggested whether, indeed, a fish behaved like salt under the circumstances!

Swedenborg's assertion that "the saline particle fits the convexity of the watery particles," and "is constantly attended by six aqueous globules," may be true, or may not. The chances are many against its truth; for such wanton fancies are rarely, if ever, verified by experience. At the time Swedenborg wrote (1721), mechanical or geometrical chemistry was in high vogue, and his conjectures would be regarded as perfectly legitimate. Lemery, a *savant* of great celebrity, contributed, in 1711, an elaborate paper to the Memoirs of the French Academy, wherein he argued that a fluid which dissolves a solid does so by pointed particles, which enter into pores of corresponding shapes and sizes in the solid. Thus nitric acid dissolves iron and copper, but not gold; because they have wide and numerous pores, and gold has not. How men had patience for such soothsaying is almost inconceivable at this day. Possibly we are quite as foolish in other ways, as posterity will in due course discover.

Dalton extended the observation of the behaviour of chloride of sodium in water over the whole series of salts with which he was acquainted. His assertion that the initial fact of his investigation was new to him is surprising, and that in its scope, as completed by him, it was "the greatest discovery that he knew of, next to the atomic theory," scarcely less so. We must remember, however, that Dalton's general information was not extensive. He was content to be ignorant of many things, that he might know a few thoroughly. He used to say he could carry all his books on his back. Moreover, in 1840, his well-worn brain was giving way, and he was writing under the exasperation of the rejection of his papers by the Royal Society.

No man holds Swedenborg's merits and memory in deeper reverence than I do, but for that reason fictitious claims advanced in his name affect me with shame and dismay. They only serve to perpetuate the prejudices against him, which I sorrowfully find to be almost insuperable.—I am, &c.

WILLIAM WHITE.

30, Thurlow Road, Hampstead,  
July 18th, 1870.

#### MISCELLANEOUS.

The Hall Testimonial.—On Thursday evening, the 14th inst., a large attendance of former pupils and friends of Mr. Thomas Hall, B.A., F.C.S., assembled at the City of London School, for the purpose of presenting that gentleman with a handsome testimonial, in recognition of his past services as Lecturer on Chemistry and Experimental Physics in that establishment. For the space of twenty-one years (since March, 1847) Mr. Hall had held this post, and successfully directed the studies of a large number of pupils, some of whom have, in consequence, acquired great distinction in the pursuit of science; and his retirement from the school was deemed a fitting occasion for presenting him with a testimonial, subscribed for last year, but only now handed to him, by reason of his compulsory absence from this country on account of ill health. The testimonial took the form of a handsome silver casket and purse of 200 guineas, and was presented by the late head master, the Rev. G. F. W. Mortimer, D.D., Canon of St. Paul's, who took occasion to testify to the successful results of Mr. Hall's teaching, and referred to a recent instance in which he had the satisfaction of presiding, at Barnard Castle, when as many as forty-eight prizes and certificates were bestowed by the Department of Science and Art on the pupils of a gentleman who was himself instructed by Mr. Hall at the City of London School. After Mr. Hall had replied, the present head master (Rev. Edwin Abbot, M.A.), Mr. W. H. Perkin, Mr. J. Spiller, Mr. E. Ryder Cook (Treasurer), and the Hon. Secretary, Mr. J. T. Brown, spoke in complimentary terms on the occasion, and the meeting concluded with a vote of thanks to the Rev. Chairman.

An Improved Method of Producing White Pigments from Lead.—(Letters Patent to J. G. Dale and E. Milner, of Warrington.)—This invention relates to an improved method of manufacturing white-lead, "carbonate of lead," by the action of the soluble acid carbonates of the alkalies on litharge, hydrated oxides of lead, or insoluble basic salts of lead. The patentees propose to carry out their invention in two ways, and when soda is the substance chosen, they proceed—(1) By mixing litharge, hydrated oxides of lead, or insoluble basic salts of lead, with an equivalent of bicarbonate of soda, together with sufficient water to form a stiffish paste. This mixture is ground in a suitable mill, small quantities of water being from time to time added as may be found requisite until the change of the lead bodies into carbonates is complete. The paste is now well washed with water, and the supernatant liquid which contains monocarbonate of soda is separated from the white-lead by filtration, and boiled down to dryness and disposed of as soda-ash; or it may be crystallised; or may be again converted into bicarbonate of soda, by treatment with carbonic acid, and used to convert further quantities of lead oxides, or insoluble basic salts of lead, into carbonates. Instead of grinding, the lead oxides, or insoluble basic salts of lead in a fine state of division, may simply be mixed with bicarbonate of soda and water and left to themselves, when the conversion into carbonates goes on in the same manner, only much more slowly. (2) They mix litharge, hydrated oxides of lead, or basic salts of lead, with caustic soda, monocarbonate of soda, or acid carbonates of soda, and sufficient water to form a stiffish paste. The mixture is now introduced into a suitable closed mill, and during the grinding a stream of carbonic acid gas is passed into it. After conversion of the lead bodies into carbonates, they are washed with water, and the supernatant liquid treated as before described. In carrying out their process by this secondly-described method, the patentees do not bind themselves to any particular proportion of lead oxides and soda, but equivalents of each answer very well. The quantity of the soda salts may, however, be reduced with advantage if found desirable. Grinding may also be dispensed with, by mixing the lead oxides or insoluble basic



salts of lead in a fine state of division with the caustic soda, monocarbonate or acid carbonates of soda, as described, and exposing the mixture in a suitable room to the action of carbonic acid. Artificial heat accelerates the conversion, both in the first and secondly-described operations, but is not essential to their success. The patentees claim the manufacture of carbonate of lead by the action of acid carbonates of the alkalies on litharge, hydrated oxides of lead, and insoluble basic salts of lead, either by direct addition, as described in their first part, or indirectly by the mixture of the lead oxides with the caustic alkalies, or their monocarbonate or acid salts, and their conversion into bicarbonates during the time they are in contact with the litharge, hydrated oxides, or insoluble basic salts of lead.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

*Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

*Comptes Rendus des Séances de l'Académie des Sciences, July 11, 1870.*

This number only contains the record of the frequently-postponed Annual General Public Meeting of the Academy, a meeting devoted to the distribution of the prizes to the authors of the different memoirs and essays written in reply to various questions in science, and found worthy, after careful scrutiny, of the honours the Academy is entitled to bestow. This number also contains the questions for which prizes are proposed to be given in the three ensuing years. From these various items, we abstract those which relate to physico-chemical sciences; in the first place—

**Annual Trémont Prize**, worth 1100 francs, is given to M. Le Roux, in order further to assist him to continue his researches on thermo-electric currents, and the determination of the indices of refraction of such bodies as do not become volatilised, unless at a very high temperature, such as mercury, sulphur, arsenic, sodium.

**The Poncelet Prize** (to be given to the author of the best work published on purely mathematical or applied science within the last ten years) is given to Dr. J. R. Mayer, at Heilbron, for his book on "Die Mechanik der Wärme" (The Mechanical Theory of Heat).

**Medals**, of the value of 3000 and 2000 francs each, are given to MM. Legros and M. Onimus and M. Cyon, for their important researches on the application of electricity to therapeutics.

**Prix Des Arts Insalubres.**—(1) To M. Pimont, for the invention of a peculiar kind of cement, a plastic material for covering steam boilers and apparatus wherein steam circulates, thereby to prevent the loss of heat by radiation; (2) to M. Charrière, for apparatus for saving life in cases of fire.

**The Cuvier Prize** is given to M. Ehrenberg, at Berlin.

**The Jecker Prize** is given, by a unanimity of votes, to Dr. Friedel, for his researches on organic silicium compounds.

**The Montyon Prize** is given to M. Arson, for his excellent researches on the flow of gas through great length of pipes.

Among the subjects for which prizes will be given, we notice—Researches to be made on the elasticity of crystallised bodies; on the theory of the rays of the spectrum; for the best work on organic chemistry.

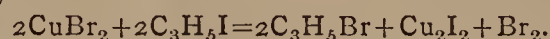
It is usual at this meeting for one of the perpetual secretaries to read an eulogising biography on one of the lately deceased members of the Academy. This year, M. Dumas read such a biography of Theophile-Jules Pelouze, born at Valogne on the 26th of February, 1807. The deceased, a celebrated chemist, was Professor at the Ecole Polytechnique and the Collège de France, President of the Mint Committee, a Member of Council of the Manufactory at Saint Gobain (glass and porcelain works), a Member of the General Municipal Council of Paris, and especially one of the most indefatigable labourers in the wide territory of physico-chemical sciences. Among the large series of his labours, we only allude, in a few words, to his extensive researches on beet-root and the manufacture of sugar therefrom; his researches on hydrocyanic acid, formiate of ammonia, and prussic ether; on oenanthic ether; on gun-cotton and xyloidine; on fermentation; on the manufacture of glass, and improvements in its composition; on lactic acid and glycerine. The eminent speaker concludes his lengthy discourse

with the following words:—"For forty years, M. Pelouze has been one of the foremost representatives of high science in France; his classical researches and discoveries, and the part taken by him in the reconstruction of organic chemistry, assign to him the rank, which will never be contested, of being one of its most eminent founders. The deceased *savant* was a member of nearly all learned Societies and Institutions of the world.

*Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 9, 1870.*

This number contains the following original papers and memoirs:—

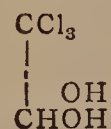
**Conversion of Organic Iodides into Bromides.**—A. Oppenheim.—The chief point of interest in this paper is that, according to the author's experiments, bibromide of copper, a salt readily and largely soluble in alcohol, is the best and most suitable material to bring about the conversion alluded to. When an alcoholic solution of this bromide is mixed with iodide of allyl, there is formed proto-iodide of copper and brom-allyl—



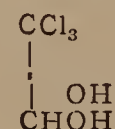
Iodide of amyl is readily converted into the bromide of allyl, when left for a few hours in contact, at 110°, with an aqueous solution of the bromide of copper.

**On Chloral.**—C. A. Martius and P. Mendelssohn-Bartholdy.—When equal equivalents of chloral and anhydrous ethylic, methylic, butylic, and amylic alcohol, or even mercaptan, are mixed together, chemical combination of these substances takes place, heat is set free, and the result is the formation of solid compounds, which may be viewed as intermediate trichloracetals. The ethyl combination boils at 115°–116°, solidifies at 40°; sp. gr., 1.143; soluble in cold water, but far more readily in ether, alcohol, acetic ether, and petroleum essence. The methyl compound boils at 98°. The amyl compound boils at 143°, is solid at 25°; sp. gr., 1.234; is not perceptibly soluble in water, but readily in alcohol and ether, from which solutions it is obtainable in crystalline state.

**Chemical Nature of the Hydrate of Chloral.**—V. Meyer.—The author says—When the constitution of the hydrate of chloral is expressed by—



it is one of those very rare exceptions to the rule that 2(OH) groups cannot be bound up with the same atom of carbon without producing, at once, an anhydride. The author's researches, as further related in this lengthy paper, are mainly undertaken with the view of establishing the true constitution of the hydrate of chloral, and for this purpose a series of complicated experiments have been made; but the chief result is that the hydrate of chloral is to be viewed as a molecular compound, which, in the state of vapour, consists of a mixture of aqueous vapour and vapour of chloral. The vapour density is 2.86; but, according to the formula—



the density ought to be 5.73.

**Relation Existing between the Crystalline Shape and the Chemical Constitution of some Organic Compounds.**—P. Groth.—This lengthy, yet very condensed, memoir sets forth that there are certain atoms, and groups of atoms, which are not, as regards their crystalline form, perceptibly affected by substitution of H for other atoms of elements; so that the original crystalline form remains, in the chief, undisturbed.

**Some New Reactions of Phenol.**—R. Lex.—The author says—Perfectly pure nitric acid (free from any of the lower products of the oxidation of nitrogen) does not, when diluted, act upon an aqueous solution of phenol; while such a solution mixed with a nitrite, and next acidified, yields, even when very dilute, a yellow colouration. If, to this solution, an excess of soda is added, a brownish colouration ensues, which is turned into a deep blue by the action of certain reducing substances—as, for instance, sugar, aluminium, zinc. The blue colour thus produced is exceedingly sensitive to the action of acids, carbonic not excepted, which cause the colour to become red; and the colouring matter thus produced is soluble in alcohol and ether. The pure nitro-derivatives of phenol do not produce this phenomenon, which, the author says, is due to the reduction of a peculiar amide body ensuing from the peculiar nitro compound of phenol produced as above alluded to.

**Composition of the so-called Wootz, or Indian Steel.**—Dr. C. Rammelsberg.—After referring, in a few words, to the ancient methods of procuring iron and steel, and stating that wootz is essentially a cast-steel, the author refers, first, to the analysis of the Indian steel made, in 1819, by the late Messrs. Faraday and Stodart, who stated that the peculiar qualities of this steel were due to silicium and aluminium; next, to the analysis of the same metal (of indisputably-genuine origin) made by Dr. Karsten and Dr. Henry, who did not find aluminium at all. The author analysed a portion of a steel bar (Indian steel, certificated for being genuine by the late East Indian Company), and deposited in the Museum of the High Polytechnic School at Berlin; the sp. gr. was found to be 7.822. The author did not find even a trace of aluminium; and, leaving iron aside, the following substances



were found in quantities, per cent:—Carbon, 0.867; silicium, 0.136; phosphorus, 0.009; sulphur, 0.002.

**The Hydrates of Platinic Acid and Platinate of Barium.**—H. Topsøe.—The author first refers, at length, to the researches of Drs. Doebereiner, Wittstein, Fremy, and others, on this subject; and next states that the hydrate of platinic acid, air-dried, is a yellowish white powder, readily soluble in solutions of soda and dilute acids, even acetic acid. Heated to 100°, it loses water and becomes iron-rust coloured. Formula,  $\text{PtO}_2 + 4\text{H}_2\text{O}$ . The acid contains 64.49 per cent of platinum. Platinate of baryta,  $\text{BaPtO}_3 + 4\text{H}_2\text{O}$ , is, when prepared with excess of baryta, a crystalline compound, containing 43.44 per cent of platinum and 33.67 per cent of baryta.

**Action of Chloride of Phosphorus upon Pyruvic Acid.**—E. Klimenko.—The author obtained, by this reaction, first, a liquid, boiling at 160°; sp. gr. at 0°, 1.2493; formula,  $\text{C}_5\text{H}_8\text{Cl}_2\text{O}_2$ . This substance, on being treated with dilute ammonia, yields a solid body, soluble in alcohol, and consisting of  $\text{C}_3\text{H}_5\text{Cl}_2\text{NO}$ . The author's investigations on this subject are not yet quite finished.

**Polymeric Modifications of Aldehyde.**—A. Kekulé and Th. Zincke.—The author's lengthy paper treats on paraldehyde and methaldehyde.

**Nitrobenzyl-Cyanide and Amidated Benzyl-Cyanide.**—E. Czumpelik.

**Some Derivatives of Cuminic Acid.**—E. Czumpelik.

**Contribution to the History of a Cymol.**—E. Czumpelik.—The length of these three papers, and the fact that the extensive series of lengthy formulæ, absolutely required for the proper understanding of the contents, would occupy too much space, forbids anything else than simply the quotation of the titles.

**Action of Pentachloride of Phosphorus upon Hyposulphite of Lead.**—J. Y. Buchanan.—The author undertook a series of experiments with the view to elucidate the constitution of hyposulphurous acid, but did not quite succeed; he states, however, that hyposulphurous acid cannot be viewed as a sulphuric acid, the hydroxyl of which has been replaced by hydrosulphoxyl.

**Contribution to our Knowledge of some kinds of Sugar (Glucose, Cane Sugar, Levulose, Sorbine, and Phloroglucine).**—H. Hlasiwetz and J. Haberman.

**Evolution of Heat Ensuing on Mixing Water and Sulphuric Acid.**—J. Thomsen.

*Revue des Cours Scientifiques de la France et de l'Etranger,*  
June 18, 1870.

This number does not contain any papers or memoirs relating to chemistry, but contains a remarkable paper on—

**Vital Power.**—Dr. Poelman.—The author states that, in addition to being subjected to the ordinary chemico-physical and mechanical forces, the living body of man is subject to a force which cannot be properly defined, but which supersedes the others, and may be called *intelligence fonctionnelle*.

June 25, 1870.

This number contains a very lengthy report, by Dr. Kékulé, on the—

**Labours of the German Chemists in the Past Year.**—This paper was read at the meeting of German philosophers and medical men at Insprück, September, last year. The meeting this year will be at Rostock (Mecklenburg-Schwerin).

**Spectroscopical Analysis of Blood.**—Dr. C. Bernard.—A subdivision of the author's very lengthy and exhaustive lecture on asphyxia by the vapour from incandescent charcoal. This paper is illustrated with woodcuts.

July 2, 1870.

This number contains—

**On the Bottom of the Atlantic Ocean.**—L. Agassiz.—A lecture, divided into the following sections:—The animal life in the depths of the Gulf Stream; geological antiquity of the existing continents; origin of erratic blocks and loose materials; geology of the bed of the Gulf Stream; madrepore formation of the Gulf of Mexico; submarine and sub-terrestrial basins; the age of the Gulf Stream; limits of the fauna of the Gulf Stream; embryonic evolution of coral, compared with its classification; geological succession, and the depth of its ordinary habitation.

**Isomerism (Allotropy) of the Elements.**—Prof. Berthelot.—A lecture, treating on sulphur in all its various phases, viz.:—As octahedric, prismatic, amorphous soluble, amorphous insoluble; soft, oily but soluble, oily but insoluble, amorphous insoluble, as obtained from hyposulphites; the absorption of heat by the solution of octahedric sulphur; heat absorbed by the fusion of octahedric sulphur; conversion of octahedric into insoluble sulphur; capability of the different sulphurs of forming compounds; combination preceded by a change of the isomeric state; relation existing between the different states of sulphur and the nature of its compounds; on phosphorus.

We regret that the length of these lectures forbids us to do more than quote the leading points thereof.

July 9, 1870.

This number contains no papers directly relating to chemistry, but we meet here with the concluding lecture of the lengthy series given by Professor C. Bernard, on the—

**Asphyxia by Charcoal Vapour.**—This portion being divided into the following sections:—Elimination of the oxide of carbon; treatment of the poisoning produced by oxide of carbon; analysis of the gas contained in the blood after inhaling oxide of carbon; is water formed in the organism?

**Successor to Professor Magnus.**—This lately deceased *savant* is to be succeeded by Professor Helmholtz, from Heidelberg University, who has been elected by the Council of Berlin University a Professor of Physics.

Cosmos, July 9, 1870.

This number does not contain any original paper on matters related to chemistry or collateral sciences. A lengthy paper is devoted to—

**The Arènes of Paris, and the Skeletons found there.**—C. Bretagne.—To be continued.

And also a paper—

**Reply to the Question, From whence do Meteorites come.**—S. Meunier.

*Revue Hebdomadaire de Chimie,* June 9, 1870.

**Ammonia Machine.**—M. Frot.—Under this title, this and a preceding number contain a description (somewhat vague) of an improvement, or invention, by the author, whereby, instead simply of steam as moving power, a mixture of steam and ammonia gas are applied; but, notwithstanding what is said about the advantages resulting from this arrangement, it is not clearly stated how these advantages are to be gained. Some of our readers will, perhaps, recollect that, many years ago, the vapour of ether and steam, although acting separately, were tried in France instead of steam alone, but with no real success.

**Furnace for the Distillation of Bituminous Shales.**—MM. Champeaus and Pinard.—By the arrangement described by the authors at length, the carbonaceous matter contained in bituminous shales is partly utilised as fuel, to cause the distillation of oils obtainable from such shales.

**Oven for the Smelting of Metals and Ores.**—A. Bon.—In main principle, the contrivance described by the author is that in use for glass-blowing and glass-house furnaces, modified in a peculiar manner, so as to smelt metals with greater ease and less loss. The author has obtained a *brevet d'invention* for this furnace, which met the approval of the gentlemen present at the last meeting of the Société d'Encouragement.

**Testing Glue.**—Dr. Chabrier.—Apart from certain well-known physical properties of good glue, the author states that its goodness (depending on the quantity of pure gelatine it contains) may be tested quantitatively for that substance by the use of nitrate of peroxide of mercury in acidulated (with nitric acid) solution, the solution having been previously titrated with a solution of pure gelatine of known strength.

June 16, 1870.

**Analysis of Hops Grown in the Elsass.**—C. Mène.—In 100 parts, this material contains—Water, 14.5; essential oil of hops, 0.5; resin, 15.9; tannic acid, 3.02; gum, 11.10; coloured extractive matter, 6.40; salts soluble in water, 0.25; cellulose and other matters insoluble in water and alcohol, 48.33.

**Manufacture of Artificial Manure from Native Phosphates.**—C. Mène.—This paper describes the preparation of superphosphate manure, but does not contain anything novel on this subject.

June 23, 1870.

**Decolouration and Defecation of Saccharine Juices by means of Phosphates and Alumina.**—M. Dominique.—The treatment of these juices remains as usual until after the defecation by means of lime; after that, phosphate of ammonia is added, until the juice is slightly alkaline; when tested with red litmus paper, a flocculent precipitate ensues, a mixture of tribasic phosphate of lime and gelatinous hydrate of alumina; this precipitate takes up all the colouring matters and other impurities, leaving the decanted liquid clear and bright. The precipitate is rich, also, in nitrogenous matter, and may be applied as manure, or, treated with sulphuric acid, for the recovering of the phosphoric acid.

**Watering the Streets with Saline Solutions instead of with Water only.**—Ch. Mène.—The author states that, of the two deliquescent salts which have been applied for this purpose—viz., the chlorides of magnesium and calcium—the last-named suits best, the quantity being adjusted at 250 grms. per square metre. It appears from this paper that, in 1860 and 1863, the Place Bellacour, at Lyon, was (experimentally, and during great heat), watered with a mixture of chloride of calcium and commercial hydrochloric acid, properly diluted in water, the effect being highly appreciated by the inhabitants also on account of the perceptible purification of the air.

**Mixture to Render Textile Fabrics Impermeable to Water and Incombustible.**—M. Imbert.—Steep the fabrics, first, in an aqueous solution of bichloride of mercury (sp. gr., 1.091); next, in a solution of protochloride of nickel (sp. gr., 1.286); then, in a solution of chloride of zinc (sp. gr., 1.359), followed by dusting over 1 part of chromate of lead; this is to be followed by an ammoniacal copper solution, and, lastly, a bath of tartaric acid. The above is exactly reproduced from the French text; but we must observe that, in the first



place, the use of bichloride of mercury, a very poisonous salt also, may affect the colours of dyed fabrics, and that no fabrics, either of wool, silk, linen, or cotton, be they white or dyed, will bear the steeping into the solutions alluded to without injury to the fibre as well as the dye. There are, for the purpose the author desires to attain, simpler and better means.

*Bulletin Mensuel de la Société Chimique de Paris, June, 1870.*

From the *procès verbaux* of the meetings of this Society, we learn that M. Berthelot related his experiments on the action of phosgen gas (oxychloride of carbon) upon the aromatic hydrocarbons. Among these, the acenaphthen is attacked, the result being the formation of a hydrocarbon less rich in hydrogen, and the evolution of carbonic and hydrochloric acids. Naphthaline is not acted upon by the gas alluded to, even at 230°, neither is benzol at that temperature; but, at 320°, that latter body is strongly acted upon, becoming carbonised, but no chloride of benzoyl is formed. The same speaker next related his researches on trichlorhydrine and bodies isomeric therewith, stating that the trichlorhydrine obtained from glycerine differs from the rest of the isomeric bodies alluded to, by yielding, in the presence of water at 160°, glycerine again. The speaker also pointed out the differences existing between the boiling-points of these isomers and that of their respective derivatives. Dr. Schützenberger related his experiments on the action of sulphuric anhydride upon the chlorides of carbon. With the tetrachloride of carbon, the anhydride yields oxychloride of carbon,  $\text{COCl}_2$ , which latter may be readily obtained in liquid state by this mode of preparation. With perchloride of ethylen,  $\text{C}_2\text{Cl}_4$ , and the anhydride, a strong reaction takes place, but the products are difficult to separate; at 60°, a liquid comes over which, on standing for twenty-four hours, deposits a crystalline compound,  $\text{C}_2\text{Cl}_4\text{SO}_3$ . The sesquichloride of carbon,  $\text{C}_2\text{Cl}_6$ , heated with sulphuric anhydride, yields the oxychloride,  $\text{C}_2\text{Cl}_4\text{O}$ , according to the following equation:—



The same speaker referred to his experiments, whereby chlorine and oxide of carbon are simultaneously made to act upon spongy platinum, the result of which is the formation of a crystalline compound, fusing at 132°; formula,  $\text{C}_3\text{O}_4\text{Pt}_2\text{Cl}_4$ .

This number contains the following original papers:—

**Some Facts relating to the Chemical History of Nitric Acid.**—E. Bourgoïn.—The chief object of this paper is to communicate the author's experiments on the action of nascent hydrogen upon nitric acid. The results of these experiments, which are related at great length, may be summarised as follows:—The action of nascent hydrogen upon nitric acid,  $\text{NO}_3\text{H}_2\text{O}_2$ , gives rise to the formation of nitrous acid, deutoxide of nitrogen, nitrogen, and ammonia. The production of nitrous acid is illustrated by  $\text{NO}_3\text{H}_2\text{O}_2 + \text{H}_2 = \text{NO}_3 + 3\text{H}_2\text{O}_2$ .

**Contribution to the History of the Metallic Benzoates.**—F. Sestini.—The author describes, at great length, the following salts:—Benzoate of potassium,  $\text{K.C}_7\text{H}_5\text{O}_2 + 3\text{H}_2\text{O}$ ; and the benzoates of sodium, magnesium, aluminium, zinc, nickel, cobalt, copper, tin, and iron. As regards the latter—viz., the protoxide salt—the author observes that it is erroneously stated, in works on chemistry, that this salt is crystallisable and very soluble. The author states that it is a salt which so rapidly oxidises, that he could not even determine its composition; while, as regards the existence of a crystalline peroxide compound of iron and benzoic acid, the author states that no such salt exists.

**Action of Vapours of the Alkali Metals upon Molten Cast-Iron.**—C. Girard and J. Poulain.—By keeping the vapours of the alkali metals at a pressure of 5 and 6 atmospheres, and temperatures ranging from 200° to 250°, and introducing into the thus-fused metals molten cast-iron, the authors produce alloys of iron and the alkali metals (potassium or sodium, or even alloys of these two). They describe, at length, the properties of the alloys thus obtained; and state that one of the practical applications of their labours bears upon the production of both steel and cast-iron of good, and even superior quality, from ores otherwise not well suited for smelting. Instead of the direct action of the vapours of sodium or potassium, the same result can be obtained on the large scale by adding, to the iron ore, fuel, and flux, a certain quantity of either chloride of sodium, or carbonate of soda, or the corresponding potash salts.

**Action of Oxychloride of Carbon on the Hydride of Octyl.**—MM. De Clermont and Fontaine.—The aim of the authors has been to try whether the general method of synthesis of the volatile fatty acids, as described by T. Harnitz-Harnitzky, is applicable to the higher class of bodies of the acetic and caproic acids series; they therefore experimented with the hydride of octyl, but found that, notwithstanding the application of all requisite means as regards temperature and pressure (sealed tubes), no action took place between the hydride alluded to and the oxychloride of carbon.

*Les Mondes, June 30, 1870.*

**Experiments made with the Oxyhydrogen-Light at Beauvais (Oise, France).**—From a letter to the Reverend editor of the above-named periodical, it appears that a successful series of experiments has been made with the view of testing the qualities of this new mode of artificial light (Tessié du Motay system), previous to its introduction into the city of Beauvais for general daily use; it appears that the oxyhydrogen-light is, in France, fast superseding the ordinary coal-gas. The population of the city alluded to is below 20,000.

**Quinquina-Chocolate.**—Dr. Heuzé.—The author has succeeded in preparing an extract of Peruvian bark so as to possess no unpleasant

bitter taste, and this is mixed with pure chocolate paste, so as to form readily-portable, and, at the same time, an agreeable, dietetic, medicine. This preparation is (thus it was stated at a meeting of the Central Imperial Society of Agriculture) considered superior to the sulphate of quinine.

**New Astronomico-Meteorological Observatory.**—The Government of the Argentine Republic, South America, have in view the establishment of an observatory at Cordova (a town of 25,000 inhabitants), at 30½° S. lat.; Dr. B. A. Gould has been appointed as Director and First Astronomer.

**Chemical Nomenclature.**—Dr. Cap.—The author states that he received from one of the Professors of Chemistry of a Departmental Lyceum, the proposal that, instead of the French names for ice (solid water), water, and steam or aqueous vapour, there should be used, *stéarhyde*, or *stéarèse d'oxyure d'hydrogenium*; for water, *calorhyde*, or *calorèse d'oxyure d'hydrogenium*; for aqueous vapour or steam, *gazorhyde*, or *gazerèse d'oxyure d'hydrogenium*. In this way the language of science would become more difficult to learn than the science itself.

**Bleaching Ivory.**—Dr. J. Artus.—The objects made of this substance are first placed into a solution, containing 227 grms. of soda (carbonate) in crystals, and 907 grms. of water. After having been left in this fluid for two days, the ivory objects are well washed in pure water, and then immersed into a solution, composed of 340 grms. of sulphite of soda, and 906 grms. of water, and kept therein, for five or six days, after which time there is added to the liquid, yet containing the ivory objects, 28 grms. of hydrochloric acid diluted with 112 grms. of water. After the acid has been added, the vessel (glass or porcelain), containing the liquid and ivory, should be covered, and left standing for from 24 to 36 hours, after which time the ivory is taken out, washed in clean water, and dried. The quantities of ingredients herein specified suffice for 453 grms. of ivory.

## NOTES AND QUERIES.

**Extract of Meat.**—(Reply to Thos. Wells.)—Refer to Dr. Dr. J. von Liebig's paper (*Annalen der Chemie und Pharmacie*, vol. 146, 1868, p. 132).

**Benzol.**—(Reply to "A Subscriber.")—Refer to the work on Aniline Dyes, by the Editor of this paper. As for apparatus, there are several dealers in these and all articles required by chemists in every large town.

**Cement.**—(Reply to "C. H.")—In all likelihood, the cement known as zeidelite will answer your purpose. Space forbids us to enter into particulars on this subject, for which we refer you to "Hand und Lehrbuch Der Technologie," von J. R. Wagner, vol. v., p. 210 and following, and to Cooley's "Cyclopedia of Practical Receipts," &c., both of which works you may inspect at the Library of the Commissioners of Patents.

**Analysis of Alloys.**—I have been analysing some alloys of copper, zinc, and tin, and was surprised at finding as much as 6 per cent of iron in them; but, suspecting the cause to be the breaking away of the teeth of the file, while minutely dividing the alloy before dissolving it, I drilled a hole in parts of the same brass with a carefully-tempered drill, and then found very slight traces of iron, indeed not more than 0.5 per cent in any case, most likely caused by impurity of the zinc used. I merely mention this as showing how careful one need be. The fact of the teeth of the file breaking away is well known to those who use them much, and consequently the cause of the presence of the iron was at once obvious.—T. W.

## TO CORRESPONDENTS.

\* \* Vol. XXI. of THE CHEMICAL NEWS, containing a copious index is now ready, price 11s. 4d., by post, 11s. 10d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our office, or, if accompanied by a cloth case, for 1s. Subscribers wishing to complete their sets of volumes are requested to apply to the publisher, who will give them information respecting scarce numbers and volumes. Vol. xxii. commenced on July 1st, and will be complete in twenty-six numbers.

J. Douglas.—This correspondent wishes for particulars of Philipp's carbo-oxygen lamp mentioned in our issue of July 9th.

H. Shuker.—If quite purified, it would answer the purpose, but it is a difficult thing to purify.

P. H. M.—The process certainly appears feasible, but we would advise you to experiment on the large scale before taking out a patent.

T. E. Thorpe.—Received.

W. H. Perkin.—Thanks for your communication.

Dr. W. H. Wahl is thanked for his courtesy. The communication will appear.

L'Abbé F. Moigno.—We have forwarded the pamphlets.

Dr. E. H. von Baumhauer.—We are much obliged for the Reports and Programme. We should have much pleasure in acceding to your request, but, unfortunately, many of the earlier numbers of the CHEMICAL NEWS are out of print.



# THE CHEMICAL NEWS.

VOL. XXII. No. 557.

## ON THE PLATIN-AMMONIA COMPOUNDS.

By S. E. PHILLIPS.

SOME twenty years ago Laurent and Gerhardt endeavoured to clear up an obscure subject by the assumption that there were two platinum—Platinicum = pt (49); Platinosum = Pt (98).

Hydrochlorate of platinosum was  $\text{NH}_2\text{Pt} + \text{HCl}$ .  
Hydrochlorate of di-platinicum was  $\text{N}_2\text{H}_5\text{pt}_2 + \text{HCl}$ .  
Hydrochlorate of platinamine was  $\text{NHpt} + 2\text{HCl}$ .

As I found the *platinicum* very conveniently chose to appear always in the twin form, I had no difficulty in discarding it, and also forgetting the *platinosum* in the orthodox platinum of that atomic weight. Since then an inverse twin process has given birth to a diatomic platinum = 197, adopted by Prof. Odling and very widely accepted.

An extended criticism of the above attempt lies before me dated 1850, pointing out the secret involved, of the ureal type of ammonia; showing how simply and clearly old views covered the complex ground taken, and bitterly complaining of the want of discrimination in mixing together simple and definite types with complex or hybrid forms as the basis of sweeping innovations.\*

In a late digest, prepared as a study in connection with the recent views of M. Wurtz, I had prepared a condensed outline statement, but I lay this aside in favour of the synopsis furnished by Dr. Odling in his lecture at the Royal Institution, June 8, 1870. My results were tabulated thus:—

### Type—AMMONIUM.

$\text{H}_3\text{HN}, \text{O}$ . Ammonium.  
 $\text{H}_3\text{PtN}, \text{Cl}$ . The chloride. (Green salt of Magnus).  
 $\text{H}_3\text{PtN}, \text{O}$ . The oxide. { (By heating the hydrate of Reiset's salt).  
 $\text{H}_3\text{PtN}, \text{Cl} + \text{PtCl}_2$ . The chloro-platinate.  
 $\text{H}_3\text{PtN}, \text{O} + \text{SO}_3$ . The sulphate.

$\text{H}_3\text{PtN}, \text{Cl}_2$ . The bichloride. { (The chloride of Reiset and Gerhardt).  
 $\text{H}_3\text{PtN}, \text{O}_2 + 2\text{NO}_5$ . The nitrate.

$\text{H}_3\text{PtN}, \text{O}_2 + \text{NO}_5$ . The nitrate. { (Under these are comprised some hybrid (?) forms with  $\text{OCl}$  instead of  $\text{Cl}_2$  or  $\text{O}_2$ .  
 $\text{HPtN}, \text{O}_2 + \text{HO}$ . The hydrate.  
 $\text{HPtN}, \text{O}_2 + 2\text{SO}_3$ . The sulphate.

### Type—ATMONIUM.

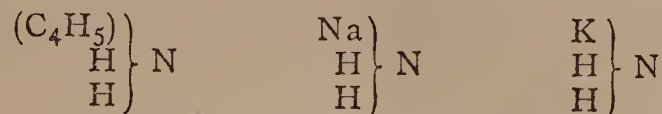
$\text{H}_6\text{PtN}_2, \text{O}$ . Atmonium.  
 $\text{H}_6\text{PtN}_2, \text{Cl}$ . The chloride. (Reiset's salt).  
 $\text{H}_6\text{PtN}_2, \text{O}$ . The oxide.  
 $\text{H}_6\text{PtN}_2, \text{S}$ . The sulphide. (Also the iodide, bromide, &c.)  
 $\text{H}_6\text{PtN}_2, \text{O} + \text{HO}$ . The hydrate.  
 $\text{H}_6\text{PtN}_2, \text{O} + \text{NO}_5$ . The nitrate. (Also two carbonates).  
 $\text{H}_6\text{PtN}_2, \text{O} + \text{SO}_3$ . The sulphate.

$\text{H}_6\text{PtN}_2, \text{Cl} + \text{PtCl}_2$ . The chloro-platinate. { (The green salt of Magnus(?))

$\text{H}_6\text{PtN}_2, \text{Cl}_2$ . The bichloride. (Series of M. Gros).  
 $\text{H}_6\text{PtN}_2, \text{O}_2$ . The binoxide.  
 $\text{H}_6\text{PtN}_2, \text{O}_2 + 2\text{NO}_5$ . The binitrate.  
 $2(\text{H}_6\text{PtN}_2, \text{O}_2) + 3\text{NO}_5$ . The sesqui-nitrate.  
 $\text{H}_6\text{PtN}_2, \text{O} + 2\text{SO}_3$ . The bisulphate.

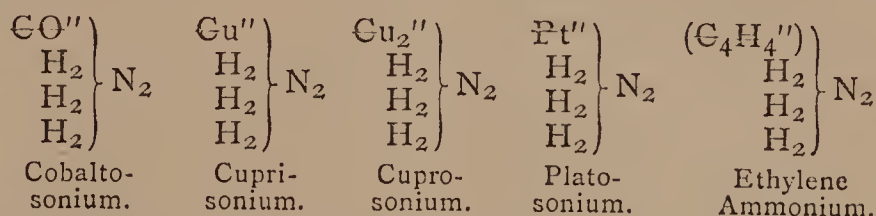
\* Dr. Odling says, "The scheme of Gerhardt, though always treated with respect, has never met with general acceptance, and now-a-days, at any rate, is open to very serious objections.

If space permitted, we might go into further details, to show that herein types and constitutions go hand in hand. The exceptional binoxide and bichloride bases are more insoluble and unstable than the more normal types, and the manifest tendency to bi- and sesqui-saltic forms is fairly paralleled in ordinary mineral types. It now only remains to enquire what has been done in this long interregnum; and here we may appropriately introduce the modern views as enunciated by M. Wurtz. He maintains that monatomic metals replace H atom for atom.



Ethylamine. Amidide of sodium. Amidide of potassium.\*

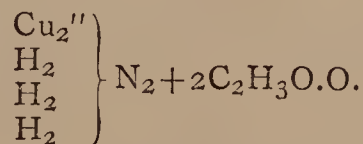
But the diatomic metals, copper, cobalt, mercury, &c., replace two atoms of H, and thus correspond with ethylene.



We object to this form of representation. As in the former case, the rule is to notate the ammonia  $\text{H}_3\text{N}$ , and the ammonium  $\text{H}_4\text{N}, \text{O}$ ; so, in the latter, the atmonia,  $\text{H}_6\text{N}_2$  or  $\text{H}_3\text{N}$ , should not be confused with the atmonium-type,  $\text{H}_7\text{N}_2, \text{O}$ . Both pairs have their well-marked and distinguishing characteristics; and the question herein is to what extent these oniums may be simply double atoms of the former.

We have the ordinary ammoniacal sulphate of copper,  $\text{H}_6\text{CuN}_2, \text{O} + \text{SO}_3$ , to which, I believe, the ordinary acetate corresponds; but the oblique rhomboidal prisms of acetate may be  $\text{H}_3\text{CuN}, \text{O} + \text{AcO}_3$ .

It is notated by M. Wurtz as—



This certainly is a new phase of diatomic fancy—to notate  $(\text{H}_6\text{Cu}''\text{N}_2)'' (= \text{H}_8\text{N}_2)$ , which, with the magic double touch, is supposed, *therefore*, to combine with 2 atoms of monatomic — (?),  $(\text{C}_2\text{H}_3\text{O}, \text{O})'$ . I know nothing of either entity as such; nor can I admire a system which seems to pride itself in calling  $\text{PtCl}_2$  protochloride of platinum, and  $(\text{C}_4\text{H}_4)''\text{Cl}_2$  chloride of ethylene. Time was when the consistency of nomenclature was studied; but, now that the requirement has multiplied itself a thousandfold, the rules of common sense are expressly violated.

I have pointed out (CHEMICAL NEWS, vol. xxi., p. 122) that copper evinces a peculiarity of isomeric change, or atomic condensation, which has not been adequately appreciated; and it is not at all improbable that Pt may exhibit the same affection. But it gives no support to diatomic theory; for, in either case, it is clearly manifest that only 1H is replaced.

All the cases given by M. Wurtz of monatomic substitution are in the type of ammonia, while all the cases of diatomic substitution involve the type ammonium; and most or all of them are capable of a simple halving of the atomic weight. If such be invalid, then it is deplorable that no evidence is given *per contra*,—the more so as Bloxam has well pointed out that such a distinction can be exemplified by their different behaviours with reagents, as ably embodied in the researches of Hadow.

Wurtz says that, when ammonia is made to act upon cuprous iodide,  $\text{Cu}_2''\text{I}_2$ , there are 4 molecules of ammonia

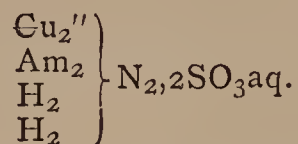
\* We have shown that the same principle holds good equally with alleged diatomic metals.



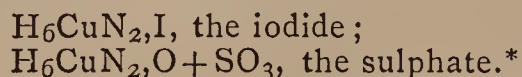


retained to a well-defined crystalline compound,  $\text{Cu}_2''\text{I}_2 + 4\text{H}_3\text{N}$ ; and, from this, as a basis, is led off another theory—that  $\text{H}_4\text{N}$  may replace 1 atom of H in a complex type of ammonia.

Thus the ordinary sulphate we have referred to becomes—



Now, why is this not a simple iodide of the type so well recognised in the ordinary sulphate alluded to, viz.—



It is in this way the ammonium of Reiset's salt is said to contain 4 atoms of N; but it is useless to wade through such numerical guesses of diatomic type without one tittle of chemical evidence or reasoning.

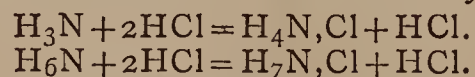
We therefore pass on to the only new fact in this connection, viz., that Hofmann "has proved that methylamine,  $\text{Me}_3\text{N}$ , may unite with bromide of ethylene,  $(\text{C}_4\text{H}_4\text{Br}_2)$ , to form a bromide. Well, be it so. But surely it is no novelty that 1Br should replace 1H; hence it may be a bromide of  $\text{Me}_3\text{EN,Br}$  where E contains 1Br replacing 1H. Moreover, it is expressly alleged in the context, with a positivity I claim no pretension to in much simpler cases, that  $(\text{C}_4\text{H}_4\text{Br})$  does replace 1H.

While ignoring the intelligent researches of Hadow, the extended play in modern memoirs upon monacid and for diatomics, diacid ammonias, is exceedingly questionable.

#### PROFESSOR ODLING'S SCHEME OF PLATIN-AMMONIA COMPOUNDS.

It is always a pleasure to sit at the feet of this gifted exponent of modern research; and anyone who has heard his unassuming and eloquent lectures at the Royal Institution must feel a pleasureable complacency in seeing that the acceptable mantle of Faraday has fallen upon such able shoulders. But, in this case, our object is rather to criticise a few weak points of a system than to enlarge on the great skill and ability which usually characterise his treatment of subjects.

The first point noticeable involves a continuation of our concluding reference to M. Wurtz—"The double ammonia unites with 2 atoms of HCl to form the hydrochloride." This, in any special sense, is precisely what we cannot see. A simple ammonia must combine with 2 atoms of HCl precisely in the same way that an atmonia or doubly-condensed ammonia does, in both cases to produce the same character of so-called "hydrochloride."



And this principle is equally paramount in the varied metallic or other substitutional forms of either type.

Of course we may numerically represent the simple ammonia as combining with 1 atom of HCl, and the "double ammonia" with 2 atoms; but, in doing so, the former is necessarily a chloride, like sal-ammoniac or chloride of potassium, while the latter is a chlorhydrate and strictly comparable hydrate of potash,  $\text{KO} + \text{HO}$ , or other hydrates or chlorhydrates. Indeed, this is really implied in the following comparative tabulation:—

Monatomic.	
$\text{KCl} \left\{ \begin{array}{l} \text{C}_2\text{H}_5(\text{H}_2\text{N})\text{H} \end{array} \right\} \text{Cl}$	$\text{KCl} \left\{ \begin{array}{l} \text{H}_4\text{N,Cl} \end{array} \right\}$
$\text{KHO} \left\{ \begin{array}{l} \text{C}_2\text{H}_5(\text{H}_2\text{N})\text{H} \end{array} \right\} \text{HO}$	$\text{KO} + \text{HO} \left\{ \begin{array}{l} \text{H}_4\text{N, O} + \text{HO.} \end{array} \right\}$
Diatomic.	
$\text{Ba}''\text{Cl}_2 \left\{ \begin{array}{l} \text{C}_2\text{H}_4''(\text{H}_2\text{N})_2\text{H}_2 \end{array} \right\} \text{Cl}_2$	$\text{Ba}_2\text{Cl}_2 \left\{ \begin{array}{l} \text{H}_8\text{N}_2, \text{Cl}_2. \end{array} \right\}$
$\text{Ba}''(\text{HO}_2) \left\{ \begin{array}{l} \text{C}_2\text{H}_4''(\text{H}_2\text{N})_2\text{H}_2 \end{array} \right\} (\text{HO})_2$	$\text{Ba}_2\text{O}_2 + \left\{ \begin{array}{l} \text{H}_8\text{N}_2, \text{O}_2 + 2\text{HO.} \end{array} \right\}$

\* A. Cahours and M. Gal (see CHEMICAL NEWS, vol. xxii., p. 22) describe new derivatives from "tri-ethyl phosphine." A prismatic, colourless salt is thus notated,  $\text{E}_6\text{PtP}_2\text{Cl}$ , and said to correspond with Reiset's salt,  $\text{H}_6\text{PtN}_2\text{Cl}$ . These modern notations are in strict accordance with those I have mooted. At  $100^\circ \text{C}$ . the salt loses 1 equiv. of tri-ethyl phosphine,  $(\text{E}_3\text{P})$ , and would therefore contain  $\text{E}_3\text{PtP.Cl}$ .

In order to lessen the amount of hypothesis in this case, I have, in the second column, preferred to notate the H elements numerically, giving the imaginary double touches their intended value. This well portrays the confusion of M. Wurtz in notating the atmonial type as  $\text{H}_8\text{N}_2$ , when we know it should be  $\text{H}_7\text{N}_2$ .

The hypothesis herein is that the simple ammonia combines with 1HCl, and the atmonia with 2HCl. Whereas we have learned throughout a wide area that both normally combine with 1 atom to form the chloride, and with 2 atoms to form the chlorhydrate; and, further, that both in common have their bichloride and binoxide variations.

The Professor notates both simple and double forms as chlorides, and yet speaks of them as "hydrochlorides."

Now, as this cannot be true of the mineral types, and as this tabular comparison is well justified in the context, the conclusion is irresistible that, in both series alike, the first is a chloride and the second is a hydrate.

These may seem small things, and, compared with the practical and profound reasonings (in an eclectic sense) of the learned Professor, I admit their relative smallness; but I hold them in high esteem, and would illustrate their importance by comparison with a contemporary difficulty with an esteemed botanist who is treating of *Proteaceæ*, *Nucumetaceæ*, and *Folliculares*.

Now, if in a certain great class of vegetables we have an important order of *Proteaceæ*, it is clearly wrong to give it a merely family designation; and, if the order be so important and its family and genera so numerous as to require special sub-division, it is clearly confusing to give one of these a family designation, *Nucumetaceæ*, and to call another, of equal value or parallel position, *Folliculares*. It is no answer to this objection to say that the generally-understood arrangement of Botany and Zoology into primary divisions—classes, orders, families, genera, and species—may suffice for a popular treatment.

No doubt the rule is in certain circles to (in some measure) despise popular teachers; and truly the task imposed on them is too severe. I am well aware that, as in Chemistry, so in Botany, these little discrepancies (if they be so regarded) are no obstacle to those whose lives are devoted to the departments in question; but to the student, and even the popular teacher, they are great impediments. And I do hold that popular teaching should be correct teaching, and that, except in the degree or amount of minutiae, it is wrong to have two standards of reference.

It will ennoble and exalt the position of our leading great men to have wider audiences; and, if the signs of the times demand a more general appreciation of the beauties and utilities of scientific knowledge, then I say that a double duty is involved. The people must and will respond by some effort on the one side; and the reports of our learned societies must be to some extent divested of a scientific jargon, which is too fatally exclusive for a reasonably wide appreciation.

But, returning to the tabulation, what may we say of the double atoms of oxide and chloride of barium? I prefer to let an accomplished chemist reply; one, moreover, who has walked and worked in the new ways.

Professor Wanklyn says:—

"That the present diatomic formulæ for salts of Ba, Ca, Mg, &c., should have come into general use, and that there should be next to no experimental support for these formulæ, is a most extraordinary thing, and speaks volumes for the depressed state of our chemical conservatives.

"The reasons in regard to some of these metals were partly some very doubtful deductions drawn from the specific heat of the metals, and mainly from considerations of the vapour-density of certain metallic compounds," &c.

I am indeed surprised and delighted to find the formidable notations of Dr. Odling agreeing so remarkably with my list above, which was projected some twenty years ago.

I now give a parallel comparative list:—



	Proposed scheme.	Old view.
PLATOSAMINE—		
The chloride .. .. .	$\text{Pt}''(\text{H}_2\text{N})_2 \cdot 2\text{HCl}$ .. .. .	$\text{H}_3\text{PtN}, \text{Cl}$
„ hydrate .. .. .	$\text{Pt}''(\text{H}_2\text{N})_2 \cdot 2\text{H}(\text{HO})$ .. .. .	$\text{H}_3\text{PtN}, \text{O} + \text{HO}$
„ nitrate .. .. .	$\text{Pt}''(\text{H}_2\text{N})_2 \cdot 2\text{H}(\text{NO}_3)$ .. .. .	$\text{H}_3\text{PtN}, \text{O} + \text{NO}_5$
AMO-PLATOSAMINE (Reiset's)—		
The chloride .. .. .	$\text{Pt}''(\text{H}_5\text{N}_2)_2 \cdot 2\text{HCl aq.}$ .. .. .	$\text{H}_6\text{PtN}_2, \text{Cl}$
„ hydrate .. .. .	$\text{Pt}''(\text{H}_5\text{N}_2)_2 \cdot 2\text{H}(\text{HO})$ .. .. .	$\text{H}_6\text{PtN}_2, \text{O} + \text{HO}$
„ nitrate .. .. .	$\text{Pt}''(\text{H}_5\text{N}_2)_2 \cdot 2\text{H}(\text{NO}_3)$ .. .. .	$\text{H}_6\text{PtN}_2, \text{O} + \text{NO}_5$
The ethyl-phosphine as notated by M. Cahours and M. Gal..		$\text{E}_6\text{PtP}_2, \text{Cl}$
PLATINAMINE (Gerhardt's)—		
The chloride .. .. .	$\text{Cl}_2\text{Pt}''''(\text{H}_2\text{N})_2 \cdot 2\text{HCl}$ .. .. .	$\text{H}_3\text{PtN}, \text{Cl}_2$
„ hydrate .. .. .	$\text{Cl}_2\text{Pt}''''(\text{H}_2\text{N})_2 \cdot 2\text{H}(\text{HO}) (?)$ .. .. .	$\text{H}_3\text{PtN}, \text{OCl} + \text{HO}$
„ „ .. .. .	$(\text{HO})_2\text{Pt}''''(\text{H}_2\text{N})_2 \cdot 2\text{H}(\text{HO})$ .. .. .	$\text{H}_3\text{PtN}, \text{O}_2 + 2\text{HO}$
„ nitrate .. .. .	$\text{OPt}''''(\text{H}_2\text{N})_2 \cdot 2\text{H}(\text{NO}_3)_3 \text{aq.}$ .. .. .	$\text{H}_3\text{PtN}, \text{O}_2 + \text{NO}_5, 3\text{HO}$
„ „ .. .. .	$(\text{NO}_3)_2\text{Pt}''''(\text{H}_2\text{N})_2 \cdot 2\text{H}(\text{NO}_3)$ .. .. .	$2(\text{H}_3\text{PtN}, \text{O}_2) + 3\text{NO}_5$
AMO-PLATINAMINE (Gros's)—		
The chloride .. .. .	$\text{Cl}_2\text{Pt}''''(\text{H}_5\text{N}_2)_2 \cdot 2\text{HCl}$ .. .. .	$\text{H}_6\text{PtN}_2, \text{Cl}_2$
„ nitrate .. .. .	$\text{Cl}_2\text{Pt}''''(\text{H}_5\text{N}_2)_2 \cdot 2\text{H}(\text{NO}_3)$ .. .. .	$\text{H}_6\text{PtN}_2, \text{OCl} + \text{NO}_5$
„ „ .. .. .	$(\text{HO})_2\text{Pt}''''(\text{H}_5\text{N}_2)_2 \cdot 2\text{H}(\text{NO}_3)$ .. .. .	$\text{H}_6\text{PtN}_2, \text{O}_2 + \text{NO}_5, \text{HO}$
„ „ .. .. .	$(\text{NO}_2)_2\text{Pt}''''(\text{H}_5\text{N}_2)_2 \cdot 2\text{H}(\text{NO}_3)$ .. .. .	$\text{H}_6\text{PtN}_2, \text{O}_2 + \text{NO}_5, \text{NO}_3$
„ „ .. .. .	$(\text{NO}_2)_2\text{Pt}''''(\text{H}_5\text{N}_2)_2 \cdot 2\text{HCl}$ .. .. .	$\text{H}_6\text{PtN}_2, \text{OCl} + \text{NO}_3$
AMO-DIPLATINAMINE (Raewsky's)—		
The chloride .. .. .	$\text{Cl}_2\text{OPt}_2''''(\text{H}_5\text{N}_2)_4 \cdot 4\text{HCl}$	
„ nitrate .. .. .	$\text{Cl}_2\text{OPt}_2''''(\text{H}_5\text{N}_2)_4 \cdot 4\text{H}(\text{NO}_3) \text{aq.}$	
„ „ .. .. .	$(\text{NO}_3)_2\text{OPt}_2''''(\text{H}_5\text{N}_2)_4 \cdot 4\text{H}(\text{NO}_3) \text{aq.}$	

I have followed herein a uniform system of halving the types given by Dr. Odling, but by no means contend that such is necessarily or in all cases correct.

Bloxam very reasonably contends that the green salt of Magnus,  $\text{H}_3\text{PtN}, \text{Cl}$ , should rather be  $\text{H}_5\text{Pt}_2\text{N}_2\text{Cl} + \text{HCl}$  (or, as in my list,  $\text{H}_6\text{PtN}_2, \text{Cl} + \text{PtCl}$ ), that is, a hydrate rather than a chloride.

In this, as in many cases, the probability is great that both forms subsist in analogous cases.

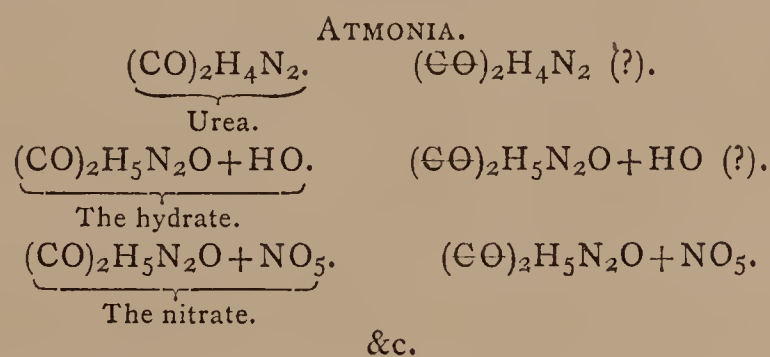
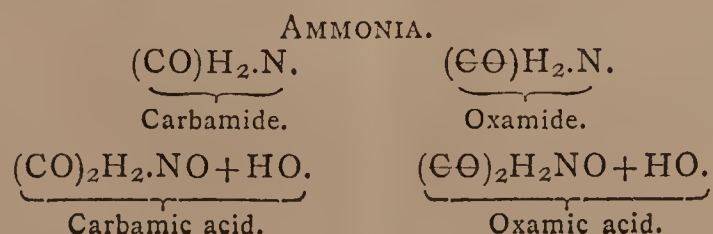
It is most improbable that all platinum substitutions (as in my list) should be mono substitutions; and it is still more improbable that all the series should contain two atoms of Pt, as in Dr. Odling's list. The truth, in all probability, lies between the two extremes; but the pity is, that, while valid bases of discrimination subsist, the matter should be left to the empiricism of individual preference and merely numerical analogies.

Platinum forms no exception to the general facts of substitutional interchange and variation, and the alleged distinctions between mono-, bi-, and tri-atomic elements of substitution may possibly prove to be as fanciful as they are elaborately and ingeniously portrayed.

If we instance the radicals of biatomic glycol, or tri-atomic glycerine, we find that both derived acids are *admittedly* monatomic. And, what is far more to the point, both are derived by an identical process to that which gives acetic acid from alcohol; and, as the latter gives either ethylamine or acetamide, so the former give their corresponding amines or amides—

Ethylamine  $(\text{C}_4\text{H}_5)\text{H}_2\text{N}$ . Acetamide  $(\text{C}_4\text{H}_3\text{O}_2)\text{H}_2\text{N}$ .  
Glycolamine  $(\text{C}_4\text{H}_5\text{O}_2)\text{H}_2\text{N}$ . Glycolamide  $(\text{C}_4\text{H}_3\text{O}_4)\text{H}_2\text{N}$ .  
Glyceramine  $(\text{C}_6\text{H}_7\text{O}_4)\text{H}_2\text{N}$ . Glyceramide  $(\text{C}_6\text{H}_5\text{O}_6)\text{H}_2\text{N}$ .

And similarly in corresponding sulpho-acids and other derived and substitutional forms. But, in regard to the platinum case in question, the radicals of carbonic and oxalic acid have a closer bearing on the subject. With these we have—



Let copper replace (CO), and we have another homologous series, where  $\text{Cu}(31.5)$  and  $\text{Cu}(63)$  equally replace one atom of H to the production of similarly-varied types.

The remarks of Dr. Odling on the platosamine group are very varied and interesting, and, in an eclectic sense, exceedingly cogent and well put.

I also believe in "the parallelism in constitution and properties of the two compounds, and of their corresponding hydrates," and, still further, that neither contains any diatomic element *per se*, or replacement of 2H; but I say nothing of ethylenamine in this connection, being engaged on an extended study of the diatomic hypothesis.

#### AMO-PLATOSAMINE.

What these are may be seen by a glance at either scheme of notation; they are simple repetitions of the preceding with  $\text{H}_3\text{N}$  superadded—in fact, they are doubly-condensed ammonias, or, as we have called them, atmonias.

#### PLATINAMINE COMPOUNDS.

In all these, the mode of preparation is instructive; they are forced conditions under the influence of nitric acid or permanganate; and hence the resulting binoxide or bichloride forms of the preceding types, which is especially manifested by the tendency to bi- and sesquialtic types so common in such cases.

It is curious to observe that the three cases selected from Raewsky are, with one little variation in the third instance, precisely double those of the first three of M. Gros's series.

In conclusion, I have merely to observe that this paper has no pretension to any adequate review of the proposed scheme of Dr. Odling, which has the great merit of associating *chemical* with other considerations, and well deserves a higher tribunal.



## ON SOLUTIONS: HISTORICAL NOTE.

By CHARLES TOMLINSON, F.R.S.

Those who take any interest in studying the history of science must have felt some surprise at seeing Swedenborg's claim to what has been considered as an important modern discovery in Physics advanced in Prof. Beswick's interesting paper in a recent number of the CHEMICAL NEWS (vol. xxii., p. 25).

Swedenborg's reputed discovery that in the solution, say, of a salt in water "the saline particle in the water does not increase the space, but only occupies the void;" or, in other words, "the mere particles of salt cannot at all add to the bulk, but only to the weight, because they occupy the spaces between the aqueous particles," is not, I am inclined to think, so Swedenborgian a proposition as Prof. Beswick supposes. I do not mean to say that earlier writers announced the fact in the same words, but the fact followed, I think, naturally from the theoretical teaching of the previous century.

For example, Descartes (born 1596—died 1650) illustrates the porosity of matter by supposing a number of apples or of bullets, very smooth and round, to be tied up in a net so as to form a compact solid. Whichever way you turn this solid and throw upon it small shot or any similar sphericules, they will pass completely through this body by their weight.

Gassendi (born 1592—died 1655), whom Bayle describes as "the greatest philosopher among scholars and the greatest scholar among philosophers," adopts a similar figure to illustrate the porosity of water. He supposes a bushel measure to be filled with wheat; there must then be between the grains certain small spaces void of grains: so among the corpuscles of water or of air, there must be small spaces which, not being filled either with water or air nor with any other body, are absolutely void.

In another place he speaks of silver dissolved by aquafortis and diffused through its little pores.

But the most remarkable passage bearing on the point in hand that I have met with in this very suggestive writer is the following:—"I have long known," he says, "that water can dissolve a certain quantity only of salt, and being once saturated with it the rest remains undissolved. Hence it occurred to me that, the salt being thus reduced to very small particles, *there must exist in the water certain small spaces capable of receiving them, which spaces being filled up, solution ceases.* It further occurred to me that the corpuscles of salt being cubical might really fill up small spaces which were also cubical. But since the same water could not only dissolve common salt, but also alum, which has an octahedral figure, but also nitre, sal-ammoniac, sugar, and other bodies, which have all different figures, there must, then, also exist in the water octahedral, &c., spaces, so that water being saturated with one of these salts is not prevented from dissolving the others. In effect, my conjecture was right; for having thrown a morsel of alum into water which some days before had been impregnated with common salt, it was dissolved just as if there had been no common salt present; and not only alum, but some other salts that I threw in were dissolved; from which I concluded that there must exist in water a number of insensible spaces of different figures; and I now understood how it was that water saturated with tinctures of rhubarb or of senna or matters ordinarily obtained by infusion is not so saturated with one as to be incapable of taking up another,"—(Vol. iii., p. 182\*).

It seems to me to follow, from the passage italicised in the above quotation, that the salt with which water is saturated (to use the words of Swedenborg once more), "does not increase the space, but only occupies the void."

Musschenbroek (born 1692—died 1761) published the

\* I quote from the "Abregé de la Philosophie de Gassendi," en vii. tomes, par F. Bernier: Lyon, 1684. There is a copy in the Library of the Royal Society "Presented by the Author, An<sup>o</sup> 1685." The original Latin of the passage quoted is in Gas. Phys., l. i., sec. i., cap. iii.

first edition of his Physics in 1726, and the second in 1734, an English translation of which was published by Colson in 1744. I have not had an opportunity of examining the original, but in the translation, p. 252, the following passage occurs:—"If fluids are composed of spherical or spheroidal corpuscles, they must leave many interstices between them, into which lesser parts can insinuate without the intumescence of the whole mass. Hence salt dissolved in water fills up the interstices, which will be done still more accurately if sugar be then added, and more still by the further addition of alum."

If by *intumescence* is meant "increase in bulk," we have the fact familiarly announced by a well-known investigator in physics in that unconscious manner in which an old and admitted fact is handled. Moreover, in the early part of this treatise there is a good deal of interesting speculation about the shapes of the porous spaces, and calculations as to their magnitudes.

In another once well-known treatise by Clare, "On the Motion of Fluids,"\* the well-worn metaphor is used in which water is represented by bullets in a barrel, the interstices between the bullets will contain a great many small shot, "the vacuities of the shot may then be replenished with a certain quantity of sea sand, the interstices of the grains of sand may again be filled with water, and thus may the weight of the barrel be greatly augmented, without increasing the general quantity.† Now this being true with regard to solids is applicable also to fluids. For instance, river water will dissolve a certain quantity of salt, after which it will receive a certain quantity of sugar, and after that a certain quantity of allom, and perhaps other dissoluble bodies, *and not increase its first dimensions.*"

Such is the teaching of all the treatises I have seen about the time when Swedenborg is said to have announced his discovery. It seems to me that the teaching was adopted from Gassendi, which, being nearly a century old, was taken so much as a matter of fact as not to require the special notice it would certainly have met with had it been first pointed out by Swedenborg in 1721-2.

Mr. Beswick supposes that, between the date of Swedenborg's book and Dalton's essay, in 1840, the important fact in question remained unknown, and consequently fruitless. We have already seen that it was not unknown; we have now to show that it was taken up as a good working suggestive fact.

In the memoirs of the Royal Academy of Sciences of Berlin for the year 1750 is a long paper, by Eller, in which are described a number of experiments for determining exactly the quantity of each kind of salt which conceals itself in the water (*qui se cache dans l'eau*) without augmenting the volume, or the vessel in which the operation is conducted becoming fuller. A glass globe of 8 ounces' capacity, with a tube fitted to the neck 10 or 12 inches in length, and 3 lines in internal diameter, was filled, for each observation, with distilled water up to a mark half way up the stem. Each kind of salt was purified and reduced to powder, the temperature being taken in degrees of Réaumur. The 8 ounces of water dissolved the following quantities of the substances named, without any increase in bulk:—

	Drs.	Grs.		Drs.	Grs.
Green vitriol ..	1	10	Seidlitz salt..	1	0
Blue vitriol ..	0	40	Sal de Seignette..	1	0
Ditto, calcined ..	2	0	Soluble tartar ..	2½	0
White vitriol ..	1½	0	Borax .. ..	½	0
Alum .. ..	0	40	Sugar of lead ..	0	40
Ditto, calcined ..	0	50	Refined sugar ..	0	30
Saltpetre, refined	1½	0	Sal ammoniac ..	1	20
Common salt ..	1	40	Fixed alkali..	2	0
Cream of tartar ..	0	50	Ammonia Carb..	0	40
Glauber's salt ..	1½	0	Gum Arabic ..	1½	0
Epsom salt ..	1½	0	And a number of other solids.		

\* My copy is the third edition, bearing the date 1747.

† Query, volume.



All the reasoning in this paper is evidently derived from Gassendi; for example, Mr. Eller says—"No one doubts the porosity of matter; and the preceding phenomena also prove, I think, the existence of interstices among the spherical bullets (*boules*) which form the ultimate elements of the water. I shall not decide whether these pores are triangular, square, pentagonal, or polygonal, so as to assist or refuse entrance to the molecules of the salts which are of different figures. Water, by its intrinsic motion, separates and divides the salt into invisible atoms, probably as small as those of the water, so that they are adapted to thread the pores of the water and become equally distributed among its mass, which holds them suspended and floating by its interior movements, notwithstanding their excess of weight. But the pores of the water being, probably, different among themselves, as the molecules of different salts are, it follows that the homogeneous molecules of one kind of salt can fill only those pores of the water that are adapted to it, while the same water can receive other molecules, whose figures are different from those of the first." Thus, 8 ounces of water saturated with  $9\frac{1}{2}$  ounces of green vitriol (at  $11^{\circ}$  or  $12^{\circ}$  R.) can still dissolve  $1\frac{1}{2}$  ounces of Seidlitz, 2 drachms of refined saltpetre, and 3 ounces of refined sugar; or, the water that has dissolved  $2\frac{1}{2}$  ounces of alum can also dissolve 6 drachms of common salt and 1 drachm of Epsom salt.

Mr. Eller also points out (page 92) that mercury will dissolve certain metals without any increase in bulk.

In the *Philosophical Transactions of the Royal Society* for 1770 is a paper by Dr. (afterwards Bishop) Watson, "On the Phenomena Attending the Solution of Salts," from which it appears that the writer failed in attempting to repeat Mr. Eller's experiments.

I have no doubt that, with a little more research, other papers might be found bearing on the point in question. At any rate, it seems scarcely justifiable that so eminent a man as Dalton should, so late as 1840, suppose himself to be the discoverer of these facts, and refer to them as "the greatest discovery I know of next to the atomic theory." Scientific workers and scientific historians form two distinct classes, and the former do not hold the latter in much esteem. In the same way, a first-rate chess player is seldom or never a good problem composer, and as the latter is never the former, he is placed on a low chess level by the Philidors of the clubs.

I ought, perhaps, to add, by way of caution to the student, that the observations of facts above quoted may require a good many *errata*; these are supplied by Messrs. Playfair and Joule (*Phil. Mag.*, xxvii., 1845).

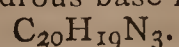
Highgate, N., July 21st, 1870.

## ON THE ANILINE OR COAL-TAR COLOURS.\*

By W. H. PERKIN, F.R.S.

(Continued from p. 42).

COMMERCIAL magenta consists of brilliant crystals, sometimes half-an-inch in length, having a beautiful golden-green metallic appearance; these dissolve in warm water almost entirely, forming an intense purplish red solution. Dr. Hofmann has carefully studied the chemical nature of magenta, and has found it to consist of the salt of an organic base, which he has called rosaniline. This base may be obtained from the commercial product, by dissolving it in water and boiling it with an alkali, or alkaline earth such as ammonia, potash, or lime; it is thus rendered nearly colourless, and after filtration rosaniline separates from the clear solution, on cooling, in colourless crystals. It is composed of carbon, hydrogen, and nitrogen when anhydrous, but generally contains an equivalent of water also. The anhydrous base has the formula—



This colourless base immediately becomes dark red upon combining with an acid, as I can show you by heating some with acetic acid, when the colour is immediately developed. The magenta produced by heating commercial aniline with nitrate of mercury is the nitrate of rosaniline; that produced with arsenic acid is the arseniate, but in the process of purification this latter salt becomes converted into hydrochlorate, which is the salt most generally found in the market. Other salts are also commercially manufactured, such as the oxalate and acetate, especially when a very pure product is required; these salts are generally prepared from pure rosaniline, by combining it with the required acid, and crystallising from water.

The acetate of rosaniline crystallises in magnificent octahedra, possessing the ordinary golden-green metallic lustre to a very high degree; it is also the most soluble salt of rosaniline known. The affinity of rosaniline salts for animal fibres is very great; it does not, however, resist the action of light nearly to the same extent as the mauve. All the derivatives of rosaniline also possess a very great affinity for animal fibres, in most cases quite equal to that of magenta itself.

When speaking of aniline purple, I showed you that by reducing agents it became colourless, or nearly so, but that the original colour was developed when it was exposed to the oxygen of the air. Salts of rosaniline or magenta are also decolourised by reducing agents, but, unlike aniline purple, the colour is not restored by exposure to the air. Dr. Hofmann has found that in this case a new organic base is produced which he has called leucaniline. This substance differs only from rosaniline in containing an additional quantity of hydrogen. It may be re-converted into rosaniline by oxidising agents such as bichromate of potassium, &c.

There is another very peculiar reaction of rosaniline. This base, when brought in contact with hydrocyanic acid, instead of forming a coloured hydrocyanate of rosaniline, yields a perfectly colourless body, which is not a salt but a base. This remarkable fact was discovered by Dr. Hugo Müller, and he has called this new body hydrocyanrosiline. We shall have occasion to refer again to this substance and leucaniline.

In the formation of magenta, a second product is obtained, commercially called phosphine. This substance was first introduced by Mr. E. Nicholson. Dr. Hofmann has investigated it, and found it also to contain an organic base, which he has called chrysaniline.

Phosphine or chrysaniline is not capable of being produced at will, and the quantity formed in the manufacture of magenta is variable. In shade it is of rather a yellow orange. This colouring matter differs from rosaniline, the base of magenta, in exactly the opposite direction to leucaniline, containing two atoms less of hydrogen. Leucaniline, rosaniline, and chrysaniline, are thus related:—



The principal use of phosphine is for the formation of a scarlet with magenta. It is not converted into magenta, nor decolourised with reducing agents or hydrocyanic acid, and, therefore, does not seem to be of the same class of colouring matters as rosaniline.

From the residues obtained in the manufacture of magenta three new colours have been obtained by Messrs. Girard and Delaire, but, I am sorry to say, my time will not allow me to enter into the particulars of these products. I believe they have not been commercially introduced as yet.

Magenta is now more used as a source of other colours than as a dye. This has caused its manufacture to be conducted on a very extensive scale, and it is now looked upon by the manufacturer as a raw material much in the same way as aniline was regarded in the early days of aniline purple.

\* The Cantor lectures, delivered before the Society of Arts.

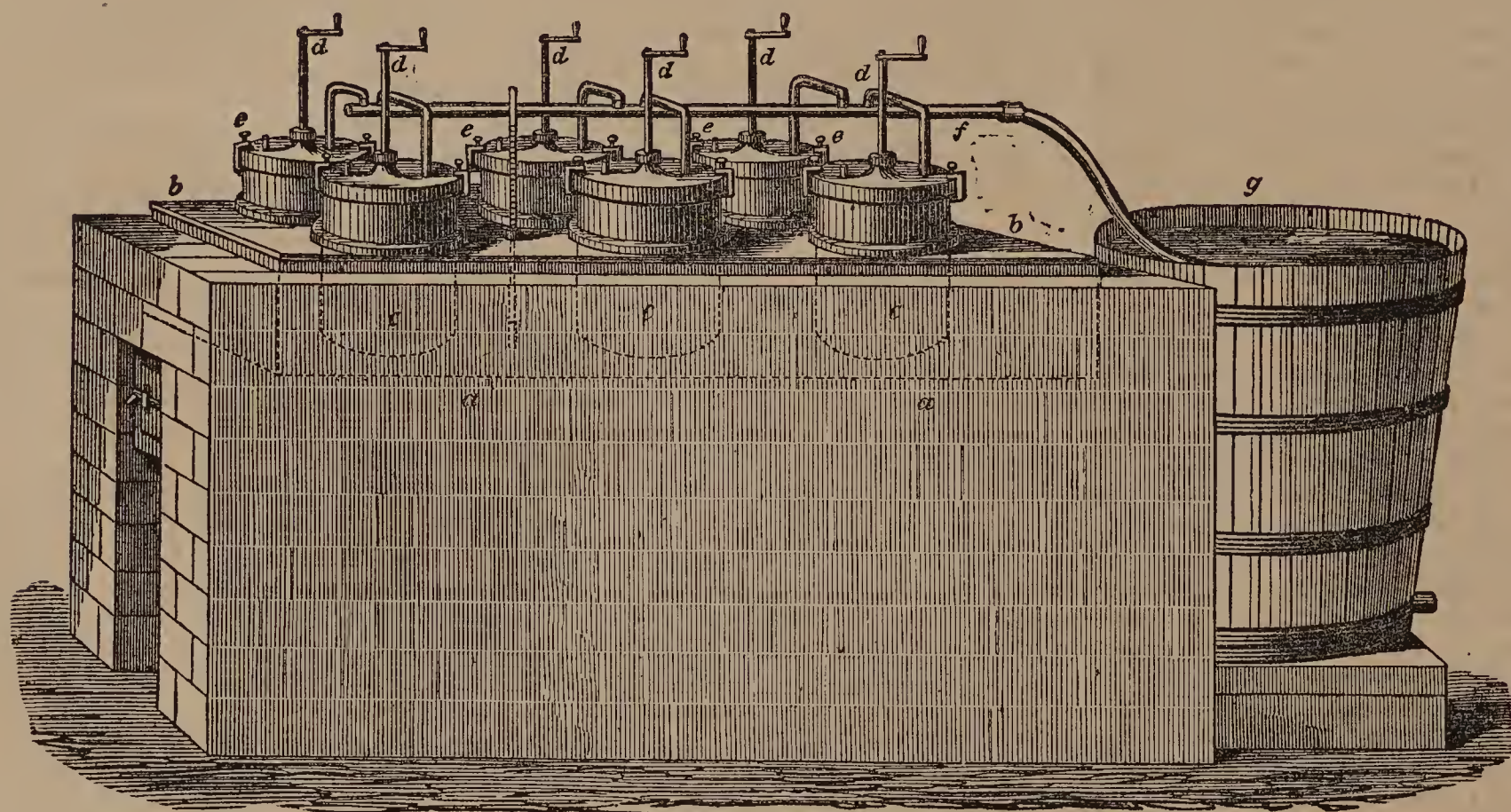


We will next consider some of the derivatives of magenta, and the first we will study is aniline blue or bleu de Lyon. If aniline be treated with a salt of rosaniline or magenta, a remarkable change takes place; at first the colour gradually becomes purple, but afterwards gets quite blue, ammonia being evolved at the same time. This peculiar reaction was observed by MM. Girard and Delaire, who found that this change of colour was due to the formation of a new body, which they termed the bleu de Lyon; intermediate products were likewise obtained, to which we shall refer presently. MM. Girard and Delaire patented their process in January, 1861. This new aniline blue is one of the most important of the artificial colouring matters, and its manufacture has been very much improved upon since its discovery. There are several circumstances which materially influence the beauty of its tint, such as the quality of the aniline and

the particular salt of rosaniline employed in its manufacture. It is found by experience that the aniline should be as pure and free from toluidine as possible, and that the salt of rosaniline should contain a feeble acid, such as the acetate, valerate, oleate, or benzoate; but why the latter is necessary chemists are unable to understand at present. Practically, the various salts of rosaniline required for the manufacture of the blue are not prepared separately, but are produced in the operation by double decomposition, which is simply a process of exchange; thus, if acetate of rosaniline is required, a mixture of hydrochlorate of rosaniline and acetate of sodium is employed; these react on each other, and change into acetate of rosaniline and chloride of sodium.

On the large scale, the process of making aniline blue is carried out in various ways, but many employ the apparatus shown in fig. 6. This apparatus consists of an

FIG. 6.



oil bath, *a*, set in a brick furnace; it has a cover, *b*, perforated with large holes; into these holes are placed small enamelled cast-iron pots, *c*, provided with a flange, on which they rest. These pots will hold from three to five gallons, and are fitted with lids held down with clamps; each lid is provided with a small stuffing-box, through which the rod of a stirrer, *d*, passes. In the lid are also two other perforations; one of these is fitted with a wooden plug, *e*, for the purpose of testing the progress of the operation; the other is connected with a bent, movable tube, *f*, united to a long central main, to collect any aniline vapour which passes over. This main is connected at one end with a worm, *g*, to condense the vapours. The oil bath by which these pots are heated is provided with a thermometer, so that the temperature may be properly regulated. In preparing the blue a mixture of magenta, acetate of sodium and aniline is introduced into the pots, the aniline being employed in excess. When charged, the oil-bath is heated up to  $190^{\circ}$  C., and kept near that temperature. At first the red colour of the mixture changes slowly, but afterwards with rapidity. The progress of the operation is ascertained by removing the wooden plug, and withdrawing a small quantity of the product upon the end of an iron or glass rod, and it is considered complete when a good blue colour has been obtained; to ascertain this point with precision, considerable experience is necessary. The excess of aniline distils during this operation, and is condensed by the worm, and collected into a suitable receiver, so that it may be used again.

From the crude blue product thus obtained, which is a fluid of the consistency of treacle, all the different qualities of blues found in the market are prepared. The cheaper qualities are obtained by simply treating the crude product several times with hydrochloric acid. This removes all the free aniline, and most of the red and purple impurities. Another similar but more effective process is employed for the preparation of the better qualities, and consists in mixing the crude product with methylated spirits of wine, and pouring it into water acidulated with hydrochloric acid, and then thoroughly washing the colouring matter, which it precipitates with water. But for the purest kinds of blue there are several processes employed; these are based upon the difficult solubility of some of its compounds in alcohol. In preparing these very pure qualities of blue, instead of starting with the crude product, one of the purified blues is taken.

(To be continued.)

**New Use for Oxygen.**—We are informed by M. Widemann, who is connected with the works of the New York Oxygen Gas Company, that the use of oxygen in renewing and increasing the flow of oil in petroleum wells has been so successful that a regular trade has sprung up in oxygen gas for this purpose. The gas is injected into the wells through tubes, and, mingling with the hydrocarbon vapours, forms an explosive mixture, which, when ignited, completely opens seams which have become clogged, and thus renews the flow.—*Scientific American*.



# A NEW MECHANICAL FINGER FOR THE MICROSCOPE.\*

By J. ZENTMAYER.

At the present time, when we are informed almost daily of some new scheme of gigantic magnitude, and while nothing short of connecting two worlds or two oceans, by cable, canal, or railroad, will create even a short-lived excitement, it may hardly seem profitable to call attention to a Lilliput engineering instrument, such as the *Mechanical finger*. But, on the other hand, while some far-sighted ones already fear this cutting through Isthmuses, tunnelling mountains, and mining whole kingdoms, might, before long, dangerously displace the centre of gravity of our earth, I can, at least, promise faithfully, that even if the instrument which I am about to describe is worked to its utmost capacity it will not appreciably disturb the equilibrium of our planetary system.

In the study of diatoms it has been long desired to find a substitute for the clumsy fingers of the human hand, to do the delicate work of picking up rare and valuable diatoms detected by the microscope and to transfer them to a glass slide for preservation.

Professor H. L. Smith, well-known by microscopists as the inventor of several valuable accessories to the microscope, first presented us with a very ingenious little instrument of this kind.

Messrs. John H. B. Latrobe and George Dobbin, of Baltimore, two expert microscopists, had in use for some time one of these instruments, but found it difficult to work it; and as the instrument was exceedingly well made, this proved that its construction was too complicated to give the firmness required in picking up a shell, less than one-thousandth part of an inch in length, and of which a single ounce of ocean sand contains, sometimes, many millions. Mr. Latrobe invited me to design and construct for him an instrument for this purpose.

The instrument requires many adjustable movements, and each of these increases its liability to shake and spring. So I made it my object to utilise such movements, of a first class microscope stand as are not essential for other specific operations, as parts of the new finger. I found in the movements of a mechanical or sliding stage the main movements required in the finger, and so attached the apparatus to the mechanical stage. This gave me two of the most important movements, with a firmness and with dimensions of parts for which, otherwise, there would be no room.

This step, however, made it necessary to provide for another stage; but as there is never a higher power than a  $\frac{3}{4}$  employed with such an apparatus, a plain stage with some simple arrangement to hold the slides would be found quite sufficient. Such a one was therefore arranged. The cut represents the finger attached to one of my large microscopes.

A is the top plate of the mechanical stage; the circular plate is omitted. The cap, B, is fitted to the lower body below the stage, into which cap the new substage, C, is fastened by a narrow tube, wide enough to admit illumination from the mirror. As the lower body is movable up and down by a rack, another movement is gained which is necessary to accomplish our result. The difference of the size of the aperture of the stage and the diameter of the tube, which connects the sub-stage with the cap, A, is equal to the movement of the mechanical stage, and this is found more than sufficient.

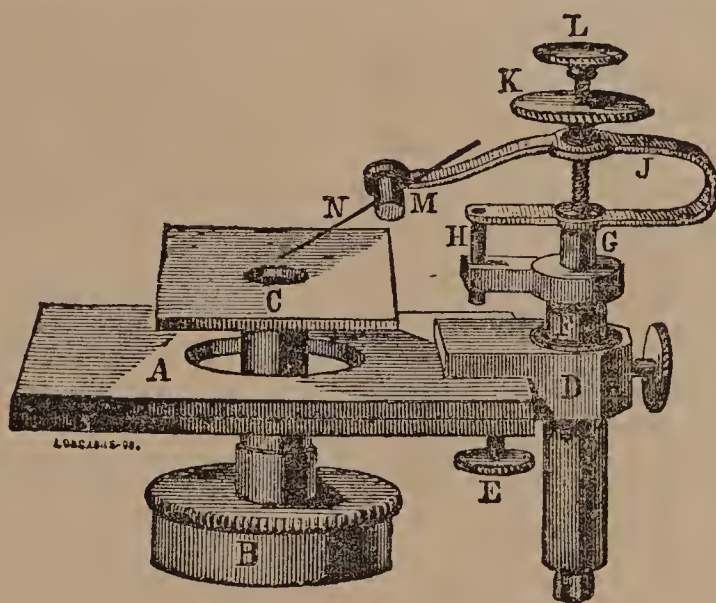
D is the clamp by which the finger is attached to the stage by means of the screw, E. A steel cylinder, G, is nicely fitted into the top and bottom of the tube, F, leaving room inside for a light spring to press the steel cylinder upwards. To prevent turning, the spring, J, is provided at H with a steel pin, accurately fitted into the fork at the top of the tube, F. By turning the

nut, K, the spring, J, is elevated and depressed, giving nice adjustment to the needle, N, in case the finger is to be attached to a microscope, not having rack-movement to the cap, B, to bring the end of the hair and the object in close approximation.

The end of the spring, J, forms a little ring, with a screw cut inside, into which a cork, M, is screwed to receive a needle, N, to which a hair is fastened by wrapping gum-paper around. Turning the cork facilitates the adjustment of the air to the proper inclination. A slight pressure on the button, L, brings down the hair, and the spring, inside of F, instantly lifts it again when the pressure is removed.

The tube, F, turns in the clamp, D, in order to adjust the hair and cork more conveniently, and when brought back again it is tightened by a set screw.

Complicated as it may appear, only one movement is added to the microscope stand by this instrument, the one, namely, which gives the vertical motion. When the apparatus is to be used, the material you want to select from is placed on the sub-stage, C, and focussed, then the point of the hair is approximately brought over



the selected object by means of the stage movements and turning of D; this brings the hair nearly in focus too, because it is almost in the same plane with the object. We next adjust the hair precisely over the selected shell, press down the button, L, and the shell will adhere to the hair. Now we remove the slide with the material and substitute a glass slide, moistened by breathing on it, and having brought it in proper position, briskly dip down the button, L, again and the shell will be deposited on the glass slide. As the mechanical stage has a graduated indicator, the finger may be moved along regularly, and shells may be placed at equal distances in lines. After the cover-glass is carefully placed over it, then Canada balsam may be run in by capillary attraction without disturbing the position of the shells.

Philadelphia, April, 1870.

## NOTICES OF BOOKS.

*Report on the Quality of the Milk Supply of the Metropolitan District* (New York). By C. F. CHANDLER, Ph.D., &c. New York: D. Appleton and Co. 1870.

THE paper before us, an extract from the Fourth Annual Report of the Metropolitan (New York) Board of Health, opens with a statement which proves that (in matters of what is very tersely, yet aptly, called *administration de la sureté et salubrité publique*) the City of New York is not only not behind, but greatly in advance of a great number of European cities and towns, where investigations as regards milk supply are, as yet, *in nubibus*. Dr. Chandler's Report opens with the quotation of two analyses of pure milk—viz., one by Dr. Letheby and one by Hardlen. The general and well-known properties of milk are next

\* Communicated by Professor Morton. From advance-sheets of the *Journal of the Franklin Institute*.



briefly alluded to, and attention called to the fact that the composition of milk is affected by a variety of circumstances, among which may be mentioned the breed of the cow, her age, the age of her calf, nature of food, and time and frequency of milking. These particulars are illustrated by quotations of various analyses, made at various epochs, by MM. Vernois, Becquerel, Chevalier, and A. Müller, put down in tabulated forms. We next find the description of the methods of analysis, as follows:—

"1. The water is determined by evaporating a weighed quantity of milk, either alone, or soaked up in a known weight of pure, fine quartz sand. The residue is carefully dried at 212° F., and weighed. The loss in weight represents the water, while the residue includes all the solid constituents.

"2. The salts are determined by carefully burning off the combustible portion of the solid residue obtained by evaporation, and weighing the incombustible ash.

"3. The butter and caseine are determined by coagulating the milk with a few drops of acetic acid, boiling, washing the precipitate with water, and finally separating the butter with ether, leaving the caseine pure. On evaporating the ether, the butter is left behind, or the butter may be extracted by ether from the residue obtained by the evaporation of a quantity of milk, soaked up in sand.

"4. The sugar is generally determined by deducting the sum of the other constituents from 100. It may be directly determined by the polariscope, after the removal of the caseine and butter, or it may be determined by an alkaline solution of copper."

The adulteration of milk is briefly, but ably, summarised in the following terms:—

"Numerous substances are mentioned as having been used, or as supposed to be used, for adulterating milk. Prominent among these are—

"1. *Water*.—Adulteration of this substance is generally detected by the sp. gr. of the milk. Pure milk varies in sp. gr. from 1.023 to 1.034, water being represented by 1.000. Milk is heavier than water, on account of the caseine, sugar, and salts, which it holds in solution. Butter, on the other hand, is lighter than water, therefore the sp. gr. of milk increases with the percentage of caseine, sugar, and salts, while it diminishes with the percentages of water or butter. It is found that good milk generally has a sp. gr. of from 1.029 to 1.032. In testing milk, the lower number is selected as a fair gravity for pure milk; and whenever the gravity falls below this number the milk may be considered as containing an excess of water, and consequently poor in quality or adulterated. An instrument, called a galactometer, has been devised by Dinocourt, for the purpose of testing the quality of milk. It is simply an areometer, so graduated that 100 on the scale represents pure milk, or the gravity 1.029, while 0 represents pure water, or gravity 1.000, the space between being divided into 100 parts. The numbers on the scale represent, therefore, the percentages of pure milk.

"Skimmed milk, having been deprived of most of its butter, is heavier than whole milk. By skimming the milk before testing it with the galactometer, the error caused by the butter is eliminated. In this case, however, the mark for 100, or pure milk, must be placed lower down on the instrument, as pure milk, having a sp. gr. of 1.029, would, after being skimmed, have a gravity of about 1.033. The 100° mark for skimmed milk is, therefore, fixed at this point.

"The *lactometer* is a simple tube closed at the lower end and graduated in hundredths. It is designed to measure the quantity of cream which rises on the milk.

"By using the two instruments together, the *galactometer* and the *lactometer*, very satisfactory conclusions, with regard to the quality of the milk, can be formed. A perfectly reliable method, though more laborious, is to actually determine the percentage of water in the milk, by evaporating a weighed quantity, and carefully drying the residue at 212° F. If a milk loses more than 88 per cent

of water, having less than 12 per cent of solids, it may be safely pronounced to be adulterated with water.

"2. *Chalk*.—This substance is generally supposed to be extensively used to neutralise the acidity in soured milk, and to produce thickness and opacity, thus concealing dilution with water. It is easily detected, as it is deposited on standing, and can then be recognised by its effervescing with dilute acids. I have never detected it in any sample of milk examined. In presence would also be shown in a milk analysis, by the unusual amount of ash.

"3. *Flour, starch, emulsions of almonds, or hemp-seed, &c.*, are said to be used to thicken milk and neutralise the blue colour caused by dilution. They were not found in any of our samples.

"4. *Sugar, gum, dextrin, and borax*, to increase specific gravity.

"5. *Turmeric and anatto*, to hide the blue colour.

"6. *Cerebral matter, sheep's brains*, to thicken watered milk, easily detected by the microscope, and by its depositing a peculiar white sediment on standing.

"7. *Carbonate or bicarbonate of soda*, to neutralise acidity. Detected by the increase in the quantity of ash, or, better, by the effervescence of the ash with acids."

The author next relates his researches on the milk as supplied to the inhabitants of New York. Four distinct series of analysis were made, the second series embracing 210 samples, the following determinations being made in each case:—(1) The specific gravity; (2) the percentage of pure milk, as shown by the galactometer; (3) the percentage of water; (4) the percentage of solid matter, including butter, caseine, sugar of milk, saline constituents, &c.; examination for adulterations. The results are printed in tabular form, and prove the following facts:—The sp. gr. varies from 1.010 to 1.032, averaging 1.0208; the percentage of pure milk, as shown by the galactometer, ranges from 37 to 110, averaging 72½; the percentage of water varies from 83.57 to 94.17, averaging 89.89; the percentage of solid constituents, the nutritive portion of the milk, varies from 5.83 to 16.43 per cent, averaging 10.11. No adulteration, save water, was found in a single instance.

The general conclusion arrived at by the author establishes the fact that the citizens of New York and neighbourhood receive milk free from injurious adulterations and untainted with disease, but adulterated with water to the extent that for every three quarts of pure milk there is added one quart of water. The quantity of water thus paid for as milk, at ten cents per quart, costs about 12,000 dollars a day, or 4,000,000 dollars annually. Our readers will agree with us that the ably-written paper, from which we have largely quoted, treats on a subject of great interest, not only to New York, but to the inhabitants of all large cities and towns, where the good example of the New York authorities may be advantageously followed.

#### *Reports on the Water Supply of New York and Brooklyn.*

Chemical Report by C. F. CHANDLER, Ph.D., &c.

Microscopical Report by WILLIAM B. LEWIS, M.D.

New York: D. Appleton and Co. 1870.

THIS paper contains, in its first part, chiefly the tabulated results of the researches and analysis, made by Dr. Chandler, of the Croton and Ridgewood waters, as supplied to the cities above-named, during a portion of last year. It appears that the Croton water contains, in 1 United States' gallon (231 cubic inches), 4.78 grains of total solid matter, while the oxygen required to oxidise the organic matter amounted to 0.0618 grains. The paper contains, also, in tabulated form, a review, showing the purity of the Croton and Ridgewood water, as compared with the waters of other American as well as European cities. Special attention is called to the presence of lead in the Croton water, derived from the leaden service-pipes and lead-lined cisterns it passes through or is kept in. A gallon



(United States) of water which had remained for six hours in the lead pipes of Dr. Chandler's residence, yielded 0.11 grains of metallic lead, a considerable portion of which was visible to the eye, in the minute white spangles of the hydrated oxycarbonate. The author states that "tin-lined," or "lead-encased block-tin" pipes, are being gradually introduced instead of the leaden pipes. These, we may observe, can be rendered perfectly safe, if, before being put down, they are internally syringed through with a strong and hot solution of any alkaline sulphide, which will very effectually convert the metal into sulphuret of lead, which, as proved by Professor Moss Pettenkofer, is not acted upon at all, even by rain or distilled water.

The able Microscopical Report, illustrated by two lithographs, shows the necessity of very effective filtration, even of otherwise pure water.

We may congratulate the citizens of New York on the care taken for their welfare by the Board of Health, and that Board for having found men who evidently are doing their utmost to promote the good health and material well-being of their fellow citizens.

## CORRESPONDENCE.

### SUPPOSED FORMATION OF OZONE DURING COMBUSTION.

*To the Editor of the Chemical News.*

SIR,—Referring to Mr. Loew's note on "The Formation of Ozone by Rapid Combustion," inserted in a recent number of the CHEMICAL NEWS, vol. xxii., p. 13, allow me to mention that, in repeating Mr. Loew's experiment, with this slight modification, that a stream of *oxygen* instead of *air* was blown through the luminous flame of a Bunsen's burner into the mouth of a glass balloon, I really found that the air in the balloon had assumed a peculiar odour, and the property of colouring blue a mixture of starch paste and kalium iodide.

Both changes are the result of the formation of a compound of *oxygen* and *nitrogen* (probably dinitric trioxide or nitric dioxide), *not* from the formation of *ozone*, as Mr. Loew asserts.

The gas in the balloon being shaken with a little water, this was unable to colour the kalium iodide starch; kalium hydroxide, however, shaken with the gas, caused a dark blue colouration in the mixture, *after having been acidified with dilute sulphuric acid*. It is almost unnecessary to add that I had first assured myself by a blank experiment that the iodide was sufficiently free from iodate not to cause errors.

With ferrous sulphate and strong sulphuric acid it gave the characteristic reaction of nitrates and nitrites.

So when Mr. Loew declares that he was able to "identify the formation of *ozone* by its intense odour and the common tests," he was a little rash in this conclusion.

The odour is that of the coloured compounds of oxygen and nitrogen, the presence of which was moreover proved by the *common tests*.

Unhappily till now, except perhaps thallous oxide, the known tests for ozone and nitric trioxide, &c., are "*common*" to both.

Still Mr. Loew's experiment is a very interesting and easy one, and will soon take its due place in the series of lecture-experiments intended to elucidate the complex phenomenon of combustion.—I am, &c.,

J. D. BOEKE, Phil. Nat. Doct.,  
Teacher of Chemistry at the Hoogere  
Burgerschool at Alkmaar.

Leeuwarden, Holland,  
July 19th, 1870.

### DETERMINATION OF FERROUS OXIDE IN SUBSTANCES INSOLUBLE IN ACIDS.

*To the Editor of the Chemical News.*

SIR,—I have read with great interest the method of estimating ferrous oxide in silicates described by Messrs. Wilbur and Whittlesey in the CHEMICAL NEWS, vol. xxii., p. 2. The method is just what was required, and will doubtless be found equally available for the analysis of such iron slags as are not completely decomposed by hydrochloric acid. The results of the analysis of Trap A. by Mr. Wilbur are not very constant, varying from 9.37 per cent to 11.95 per cent of ferrous oxide, and I am inclined to believe the fault lies in the method of titration employed.

It has been repeatedly shown that the presence of hydrochloric acid interferes appreciably with the estimation of iron by permanganate, while it does not affect Penny's bichromate process. If the former oxidising agent be employed, the solution should be effected by means of sulphuric acid.

This source of error seems to have escaped notice almost entirely, although most distinctly pointed out in "Fresenius," and also in Sutton's "Volumetric Analysis."

*Apud* of the estimation of ferrous oxide in difficultly soluble compounds, I may mention that solution may frequently be effected by heating with hydrochloric acid under pressure. I have used this method very successfully in the analysis of various titaniferous iron ores and sands. About a gramme of the finely powdered mineral is heated in a sealed piece of combustion tubing, half full of fuming hydrochloric acid. At first the heat of a water-bath is sufficient, but after a few hours the temperature is gradually raised to 140° or 150° C. The ore is completely decomposed in four or five hours, and after the tube has cooled the end may be broken under water, and the ferrous oxide at once estimated by bichromate.

Of course the same method will yield a solution suitable for the determination of the other constituents of the ore.—I am, &c.,

ALFRED H. ALLEN, F.C.S.

School of Chemistry,  
Sheffield, July 23rd, 1870.

### COMPOSITION OF CARMINE.

*To the Editor of the Chemical News.*

SIR,—In your review of Mr. J. W. Slater's "Manual of Colours and Dye Wares" (CHEMICAL NEWS, No. 556), Mr. Slater is severely criticised for stating that carmine is the colouring matter of cochineal in a pure state combined with alumina. You say, "It is readily soluble in ammonia, and does not contain alumina at all," implying, at the same time, that this fact was brought about by recent researches.

Permit me to say that I have been for several years engaged in working out the chemistry of carmine, and perfecting the method of its preparation on a large scale, and that, according to my experiments, carmine, although easily soluble in ammonia when pure, is an alumina compound.—I am, &c.,

HUGO MÜLLER.

[In both the French and German editions of Schützenberger's work on Dye Materials, recently published, it is said that perfectly pure carmine does not contain any alumina, and, moreover, leaves no ash on its ignition. This author also states that there are different qualities of carmine met with in commerce, and that only the more ordinary qualities contain alumina. A similar statement to the above is also contained in the "Handwörterbuch der Reinen und Angewandten Chemie, Art.



Carmin," written by J. von Liebig, and in Persoz's standard work, "De L'Impression des Tissus." The reviewer may also refer those who are interested in the subject to the mode of preparing carmine of Madame Cenette, in which (as may be learned from the detailed description of this process, in Ure's "Dictionary of Arts, &c.," 6th edition, vol. i., p. 654; and also Cooley's "Cyclopædia of Practical Receipts," 4th edition, p. 399) no alum whatever is used; whilst the result is the production of the finest carmine of great purity. In the book reviewed, the author has not made any distinction between the different qualities of carmine and carmine lake, and speaks about carmine as if it were a well-known chemical compound of alumina, which it certainly is not. Of course, when so eminent a chemist as Dr. Müller says that alumina is an essential constituent of pure carmine, we accept the statement as correct; but, as it is a fact which was unknown to Schützenberger, Persoz, Ure, Von Liebig, as well as to Madame Cenette, a most successful manufacturer, the reviewer may, perhaps, be excused for not being acquainted with it.—THE REVIEWER.]

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

*Comptes Rendus des Séances de l'Académie des Sciences*, July 18, 1870.

This number contains the following original memoirs and papers relating to chemistry and collateral sciences:—

**Magnetic Rotatory Power of Liquids.**—A. de la Rive.—The author, in a letter to M. Dumas, states that he has just finished a series of experiments on the above-named subject, the results of which will be shortly published. The first portion of this work is devoted to the description of the apparatus and processes of experimentation; the second part contains the results of the determination of the magnetic rotatory power of some liquids. As a curious anomaly, the author mentions that, taking water as unit, the coefficient of the magnetic rotatory power of monohydrated sulphuric acid, ( $\text{HOSO}_3$ ), is 0.750, and that coefficient is, for liquid anhydrous sulphuric acid, ( $\text{SO}_2$ ), equal to 1.240 at a temperature of 12°. The third part of this work is devoted to the study of the influence of the temperature on the magnetic rotatory power. In the fourth part, the author gives the results of his investigations of the magnetic rotatory power of a mixture of two liquids, as compared with that each of these liquids possesses separately. The fifth part contains the results obtained by experimenting with two isomeric liquids.

**New Researches on the Electro-Capillary Action: Formation of Crystallised Oxychloride of Copper and other Analogous Compounds.**—M. Becquerel.—This paper contains another instalment of the author's researches, which have occupied his attention for a series of years. The artificial formation of the oxychloride of copper in crystalline state, and exactly similar to that found in the copper mines of Peru and Chili, and known as atacamite, has taken no less than fifteen years.

**Observations of the Underground Temperature in the Jardin des Plantes, at Paris, from 1864 to 1870.**—A. C. Becquerel and E. Becquerel.—From this lengthy paper, we learn that, at 36 metres below the surface, the temperature is constantly 12.47°, and that at a depth of from 36 to 26 metres a very slight difference only is observed. The paper contains a lengthy series of tabulated results.

**Variations of Temperature produced by the Mixing of Two Liquids.**—H. Sainte-Claire Deville.—A sharp reply to the last communication on this subject by M. Jamin.

**Reply to the Criticism of M. Jamin in reference to a paper published in 1860.**—H. Sainte-Claire Deville.

**Researches on the Action of the Chlorides of Platinum, Palladium, and Gold upon Phosphines and Arsines.**—A. Cahours and H. Gal.—This lengthy memoir is divided into the following sections:—Action of bichloride of platinum upon arsines; action of chloride of palladium upon triethyl-arsine; action of sesquichloride of gold upon triethyl-arsine.

**Thermal Researches on the Metallic Character of the Alloy of Palladium with Hydrogenium, and on a Voltaic Element wherein Hydrogenium is the Active Metal.**—P. A. Favre.

**Possibility of Obtaining Luminous Signals Visible at Great Distances.**—F. Lucas.

**Photographical Studies of the Sun at the Imperial Observatory at Paris.**—L. Sonrel.

**Decomposition of Oxalic Acid.**—P. Carles.—The author describes, at length, a series of experiments, the chief result of which is that a current of even an inert gas (as, for instance, hydrogen or nitrogen) decomposes, or, rather, dissociates, at 100°, a concentrated aqueous solution of oxalic acid.

**Conversion of Chloral into Aldehyde by Inverse Substitution.**—J. Personne.

**Crystalline Compounds of Oxide of Lead and Oxide of Antimony, and of Oxide of Lead and Antimonic Acid, from the Province of Constantine (Algeria).**—M. Flajolot.—The minerals just mentioned are—A compound of oxide of antimony and lead,  $\text{Sb}_2\text{O}_3 \cdot 2\text{PbO}$ ; sp. gr., 7.02; colour, smoky brown; hardness, that of carbonate of lime; soluble even in dilute hydrochloric acid, if applied in large bulk, and also in a mixture of dilute nitric and tartaric acids. The other mineral consists, in 100 parts, of—Oxide of antimony, 4.80; antimonic acid, 35.50; carbonic acid, 4.20; oxide of lead, 51.50; water, 4.0. Formula,  $\text{Sb}_2\text{O}_5 \cdot \text{PbO} + \text{CO}_2 \cdot \text{PbO} + 2\text{H}_2\text{O}$ . Besides these crystalline compounds, the same mineral vein, chiefly containing calamine stone, contains an amorphous ochry substance, consisting, in 100 parts, of—Antimonic acid, 63.50; sesquioxide of iron, 31.40; water, 5.10. Formula—



These minerals occur at a distance of 60 kilometres to the south of Bône, near to a thermal spring much frequented by the Arabs, and known as Hamman-Nbaïl-Nador.

*Programm der Königlichen Rheinisch-Westphälischen Polytechnische Schule zu Aachen, für den Coursus, 1870-71.*

Under the above title, the director of this school (which was briefly alluded to at page 23 of our present volume), has kindly forwarded to us this volume, containing, beside some sixty pages letter-press, several tabulated forms (of which more presently); also a series of engravings representing the plans and outline of the building. From this work we abstract the following:—On November 14th, 1863, His Majesty the King of Prussia decreed that Aachen City (Aix-la-Chapelle, Charlemagne's imperial residence) should be the seat of the High Polytechnic School to be established for the Rhenish provinces and Westphalia, and on the 15th of May, 1865, the anniversary of the fiftieth year of the annexation of the Rhenish provinces to Prussia, His Majesty laid the foundation stone of the building, in the portico of which are placed the marble busts of the King and the Prince Royal. The walls of the building are made, in the first place, as far as the foundation and basement are concerned, of trachyte from the Drachenfels, near Bonn; next follows red sandstone, from the neighbourhood of Trèves; while the higher stories are executed in tuffstein, from Brohl (a kind of volcanic stone). The façade of the main building is in the early Italian renaissance style, bearing the coats of arms of the city of Aix-la-Chapelle, of Rhenish Prussia, of Westphalia, and the allegorical representations of science as Minerva with the Prussian eagle and of Borussia. The building is constructed to accommodate, with ease, 500 students, and covers a surface of 28,517 square feet. The so-called aula (a large lecture-room) is ornamented with medallions bearing bas-relief busts of the following celebrated men, the names of some of whom may, however, not be well-known to our readers:—Von Dechen, Beuth, Werner, Von Liebig, Bunsen, Magnus, Dove, Karmarsch, Bessel, Schinkel, Mellin, Von Buch, Von Humboldt, Klaproth, Mitscherlich, Liebnitz, Gauss, Redtenbacher, Borsig, and Hagen. The building is heated by hot water, and contains four tanks, each of 1000 cubic feet capacity, which are filled by means of steam pumps. Water is laid on throughout the building so as to be accessible for use in every part thereof, and also to serve in case of fire. A very good clock, with large dial-plate, and striking the hours and half-hours, is placed in the portico of the building, and, by means of electricity, the laboratory clock-dial is in connection with that of the main building. The chemical laboratory is not situated in the building just alluded to, but is a building by itself, standing in the garden and behind the main school-building. This laboratory building consists of basement and two stories (it covers 7912 square feet), and is divided into two main sections, one of which is devoted to pure, the other to technical or applied chemistry. Each of these sections contains complete laboratories, fitted up with all modern requirements, and arranged so as to accommodate, beside, sixty students for practical chemistry classes and the investigations for more advanced students. The staff attached to this establishment consists of a director; 3 heads of special schools (viz., for engineering and architecture, engine construction and mechanical technology, and chemical technology and metallurgy); 17 ordinary professors; 7 extraordinary professors; 7 assistants; 4 private teachers; a general secretary and treasurer; a librarian and scientific correspondent; and, further, 1 housekeeper (*castellan*) for the main building, 1 ditto for the laboratory, 3 porters for the laboratory, 1 machinist and foreman of the workshop, 2 stokers, and a general male servant. It is quite impossible to enter into details about the lectures, or to give any adequate description of the amount even of the material means provided to aid the instruction in this noble institution. The expenses of first establishment are £80,310, and of this £7800 has been spent upon the chemical and chemico-technical portion and laboratories, over and above the expense incurred by the separate building. None



of the students will reside in the building, which is not a college, in the sense that word is usually applied; and, in order to make clear for them the courses of lectures they will have to attend, tabulated forms have been added to this volume, one of which is very ingeniously contrived, being partly printed in colours and letterpress text, and the whole so arranged that the white spaces indicate the courses to be attended to by the students of the first year, yellow second year, green third year; the fourth year for architects and engineers is red, and for mechanico-technics blue. The lectures commence at 8 a.m., and, with the exception of 1 hour's rest, continue till 6 p.m. We may not neglect to observe that the Prussian Government has provided liberally for the proper maintenance of this school, which has been planned with the view of rendering the instruction to be given readily accessible to all. The Aix-la-Chapelle and Munich Fire Insurance Company has liberally made a grant of a capital of £3000 to the school, the interest of which is to be applied to assist some few students to pursue their studies, under certain regulations. The School is to be opened on October 10th next.

*Revue des Cours Scientifiques de la France et de l'Etranger*,  
July 16, 1870.

This number does not contain any original papers on chemistry or collateral sciences, but we notice briefly—

**Manufacture of Glass.**—M. Bontemps.—Under the title of "Guide du Verrier, Traité Historique et Pratique de la Fabrication de Verres, Cristaux, Vitraux" (that is to say, The Glassmaker's Guide, Historical and Practical Treatise on the Manufacture of Glass, Crystal, and Sheet Glass), the author has published a large amount of information, valuable not simply for France, but also for other countries. The extent of the glass manufacture in the country just named may be inferred from the following few scraps:—The total annual production of all kinds of glass, bottles inclusive, is 177,300,000 kilos; the weight of the raw material for this production amounts to 220,260,000 kilos.; weight of fuel required, 557,500,000 kilos.; number of workmen engaged in this branch of industry, 20,000.

*Cosmos*, July 16, 1870.

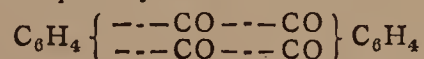
**Utilisation of the Waste Heat of Gas-Work Furnaces.**—V. Meunier.—The author proposes that the waste heat shall be applied to the heating of the air which is required to keep up the combustion of the fuel intended to keep the retorts at the requisite degree of heat. This proposal may be executed in practice in various ways, but it appears that the best plan is the construction of brick chambers, wherein the products of the combustion are made to pass in a zigzag manner previous to entering the chimney-stalk, and to heat the air contained in tubes.

**Painting by means of Injection.**—M. Violette.—The author employs a so-called pulverisator (spray-producing machine) for the application of pigments and dyes to the surface of textile fabrics, paper, &c. The coloured liquid is projected in an impalpable spray, and made to fall on the objects to be painted or dyed, as the case may be.

*Berichte der Deutschen Chemischen Gesellschaft zu Berlin*, No. 10, 1870.

This number contains the following original papers and memoirs:—

**On Phthalyl.**—E. Ador.—The author, in the first place, describes at length his experiments on the elimination of chlorine from organic combinations, by means of finely divided silver; by this means the chloride of phthalic acid has been decomposed, and phthalyl obtained as a solid substance, insoluble in water, very difficultly soluble in alcohol, ether, chloroform, and sulphide of carbon, not attacked by bromine and sulphuric acid, and sublimable at a high temperature; boiling nitric acid oxidises phthalyl, yielding phthalic and diphtalylic acid. The formula of phthalyl is—



The author in this lengthy memoir enters into full details on the constitution of phthalyl and compounds derived therefrom.

**Reduction of Isatine to Indigo Blue.**—A. Baeyer and A. Emmerling.—The authors state that when isatine, previously pulverised, is mixed with fifty times its weight of a mixture of equal parts of terchloride of phosphorus and chloride of acetyl, to which some phosphorus is added, and this mixture is heated for several hours to from 75° to 80° in a sealed tube, and the bright green coloured liquid contained in the tube poured into a large bulk of water, next filtered, and then left standing for 24 hours in a large basin, a dark blue pulverulent substance is gradually deposited, which, being collected on a filter and washed with alcohol, yields a body in all its properties fully identical with indigo blue. The quantity so obtained varies from 10 to 20 per cent of the weight of the isatin employed. The authors enter at great length into collateral matters of interest as regards the synthesis of indigo blue; but unless we were to produce a series of complicate formulæ, we could not give any useful abstract of that portion of their paper.

**Action of Solid Chloride of Cyanogen upon Benzylic Alcohol.**—S. Canizzaro.—By the action of the solid chloride of cyanogen,  $\text{Cy}_3\text{Cl}_3$ , upon benzylic alcohol, the author has obtained three different substances, viz., a small quantity of a solid body crystallising in the shape of small needles, fusing at 153°, and which may be a cyanide of

benzyl, but owing to the very small quantity obtained of this substance, the author could not say for certain; next another solid body, crystallising in large prismatic shaped crystals, and containing, in 100 parts—Carbon, 75.31; hydrogen, 6.15; nitrogen, 11.19; lastly, another solid body, fusing at 86°, and found to be benzyl urethan—



**Synthesis of the Oil of Rue.**—Gorup-Besanez and F. Grimm.—After referring at length to the researches made by a great number of authors for the purpose of the artificial production of the oil of rue (*Ruta graveolens*), the authors state that they succeeded in obtaining this product synthetically, by the dry distillation of equal molecules of capriate and acetate of lime. This is the chief point of interest in this lengthy memoir, which contains a lengthy description of the experiments and discussion on the rationale of the reactions.

**Contribution to our Knowledge of Meteorites.**—C. Rammelsberg.—The author describes a series of minerals, and states that, in his opinion, the true nature of meteorites can only be learned by paying attention to the composition of the minerals constituting those bodies.

**Non-existence of the Chlorocyanide of Hydrogen.**—A. Naumann and E. Vogt.—The authors state that while experimenting upon the dissociation of gases and vapours, they have found that the chemical compound  $2\text{CyCl.CyH}$  does not exist as such, but is simply a mechanical mixture of chloride of cyanogen and hydrocyanic acid.

**Action of Bromine upon Dichlorhydrine.**—A. Claus.—A reply and critical review of Dr. Carius's papers on this subject, published in No. 8 of this periodical.

**Action of Chloride of Sulphur upon Aniline.**—A. Claus.—Only a preliminary communication.

**Researches on the Ether Derivatives of the Polyatomic Alcohols and Acids.**—L. Henry.—Fourth paper on this subject, containing the following sections:—On different nitric ethers, nitric ether of the ethylglycol, nitric ether of the alcohol acids.

**Elementary Bodies.**—C. W. Blomstrand.

**Constitution of the Combinations of the Camphor Group.**—H. Hlasiwetz.—Chiefly a series of very lengthy and complicated formulæ.

**Contribution to our Knowledge of the Anthracen Pigments, and on the Preparation of Anthracen in Pure State.**—V. Wartha.—This paper is too lengthy and too concisely written to admit of any useful abstraction.

**On Azotoluol and some of the Derivatives thereof.**—This memoir is divided into the following chapters:—azotoluol, azoxytoluol, hydrazotoluol, tolidin.

**Basicity (Basicität) of Acids.**—F. Mohr.—An exhaustive and lengthy essay.

**Occurrence and Elementary Composition of Vegetable Wax.**—J. König.—This memoir contains chiefly the results (in figures) of a series of experiments made with a variety of fresh and dried vegetable matters, hay, straw of various kinds of corn, &c.; also researches on the wax contained in the excrements of cattle, horses, and sheep fed with these vegetable products.

**The Association for Mineral Oils at Halle on the Saale.**—This body corporate desires to obtain: 1. The best information concerning the chemical means of purifying crude paraffin cakes, so that the loss of paraffin does not thereby rise above 5 per cent: 2. A contrivance whereby materials containing paraffin may be cooled down at any season of the year to at least  $-5^\circ\text{C}$ . In reference to No. 1, among other conditions are—that are excluded from use such substances as colourless tar oils, benzine, and, generally speaking, any substances which either dissolve or alter paraffin, the operation, moreover, ought to be readily executed and suitable for working on the large scale: the paraffin should be free from smell, and be of a bluish white colour. In reference to No. 2, the contrivance ought to be such as to enable to cool down daily at least 500 cwts. in quantities of 5 cwts. at a time. The association is inclined to give two premiums, each at £750 value, for the best of the contrivances asked for, the time being fixed for the 1st of January, 1871. Apply to the Mineralöl-Verein zu Halle a. d. S. Prussia. The committee of examination consists of several parties, among whom M. A. Riebeck at Halle.

*Les Mondes*, July 7, 1870.

**Universal Origin of the Prototype of the Measures of Length.**—Dr. Rodenbach.—The author says the elbow-length of a well-developed man is the third part of the mean height of men all over the world, and that length, equal to 0.54 metre (taken three times, equal to 1.62 metres, the average height of men on the globe), has served to derive therefrom all linear measures, and from these have been derived the surface (square) and cubical measures, as well as weights, and, in later times, has become (with Assyrians, Chaldeans, and Egyptians) the basis, also, of the monetary system.

**Movable Rotating Gas-Burner Producing a Helicoidal Flame.**—M. C. Woestyne.—This burner, according to what is here stated, consumes gas very completely, so that no smoke or soot is ever produced, and the activity of the combustion (fed by 60 cubic metres of air = 1919.2 cubic feet per hour) both renders the light brilliant, and is a great auxiliary to ventilation.

**Inclination of the Axis of the Basilica of St. Peter, at Rome.**—Rev. Father Angelo Secchi, S.J.—This eminent *savant* writes to the Editor of *Les Mondes* on this subject, explaining the cause of what now



is clearly made out to have been an optical illusion (alluded to in the CHEMICAL NEWS, vol. xxii., p. 24), traced by the writer of this note to its due cause, who, however, does not fail to point out some irregularities and eccentricities in the building alluded to, but which, as a consequence of its enormous size, are not perceptible, unless by very careful survey. The author's object in writing on this (at Rome) well-known subject is to prevent the rumour getting abroad of defects existing which impair the stability of the Basilica, which, having been thoroughly surveyed, is found as firm as a rock. M. Narducci writes also on this subject, and both letters will greatly interest builders and architects especially.

**Explosion of Picric Acid Induced by Ozone.**—Rev. F. Moigno.—When picric acid is introduced into a vessel containing ozone, a violent detonation instantaneously takes place, a new proof of the danger attending experiments with nitrogenous compounds containing nitrogen only loosely bound.

**Curvigraph.**—M. Bellanger.—A description, accompanied by woodcuts, of a very useful instrument, intended to draw upon paper all curved lines and curvilinear figures of which a certain number of points are known.

**Centrifugal Mixer.**—C. Woestyn.—A lengthy description of a contrivance, especially suited to operations in sugar refineries, to separate, from viscous fluids, solid and liquid matters.

**Aspirating Ventilator.**—Damboise-Bénard.—With woodcuts. A very ingenious contrivance for getting rid of foul air, as well as sucking fresh air in simultaneously.

**Continuous Syphon, and Substitution of Syphons for Pumps in Drainage Works, &c.**—M. de Lagillardais.—With woodcuts. Useful and ingeniously-made apparatus.

July 14, 1870.

**Inauguration of the Kepler Monument.**—On the 24th of last June, the very small Swabian town named Weildiestadt, with hardly 2000 inhabitants, was the scene of a festive gathering for the purpose of unveiling the statue of the celebrated Kepler, who was born in an humble cottage yet existing, and now known as Keplerhaus. The statue of the celebrated astronomer, executed in bronze, represents him seated on an arm-chair; in his left hand, supported by a celestial globe, he holds a scroll, upon which an ellipse is delineated; in his right hand he holds a pair of opened compasses. At the four corners of the pedestal, upon which the statue is placed, are smaller statues, representing Michel Mastin, the Tübingen professor who taught Kepler mathematics, and Nicholas Copernicus, Tycho-Brahé, and Jobst Byrg, who assisted Kepler in making astronomical instruments. On the centre of the pedestal is simply placed "Kepler"; the other sides of this portion of the monument are embellished with bas-relief representations of incidents of Kepler's life.

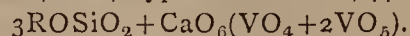
*Journal für Praktische Chemie*, No. 10, 1870.

This number contains the following original memoirs and papers:—

**The Polybromides of the Tetra-Ammonium Bases.**—P. C. Marquart.—Conclusion of this memoir, to which Prof. Kolbe has added a short paper on the—

**Highest Capacity of Saturation (Valenz) of the Elementary Substances.**

**Composition of Lawrowite and Vanadiolite, a New Mineral.**—R. Hermann.—After referring at some length to the history of the two minerals above-mentioned, the author says:—Lawrowite, named after a Russian mineralogist, is a substance of 3.04 sp. gr., exhibiting a grass-green colour and glassy lustre. Heated before the blowpipe-flame it fuses to a bright green-coloured glassy mass, does not lose any weight by ignition, and contains, in 100 parts:—Silica, 53.65; alumina, 2.25; protoxide of iron, 2.48; lime, 23.05; magnesia, 16.0; hypovanadic acid ( $\text{VO}_4 + 2\text{VO}_3$ ) (*untervanadsäure*), 2.57. Vanadiolite, sp. gr. 3.36, fuses before the blowpipe-flame at the edges, forming a black slag. It is a crystalline, nearly black-coloured, body, consisting, in 100 parts, of:—Silica, 15.61; alumina, 1.10; protoxide of iron, 1.4; lime, 34.43; magnesia, 2.61; hypovanadic acid, 44.85; formula—



**Probable Identity of Laxmannite and Vauquelinite, and on Phosphorchromite, a New Mineral.**—R. Hermann.—The first part of this memoir contains a discussion, illustrated with the results of a series of analyses made by the late Berzelius and Dr. Nordenskjöld, and here mutually compared to prove that laxmannite and vauquelinite are identically the same, both as regards their chemical composition as also their mineralogical features. As regards the phosphorchromite, this mineral has been, the author says, also confused with vauquelinite, but, since the author's analysis has proved that this mineral contains far more oxide of lead than vauquelinite, he has termed it phosphorchromite, consisting, in 100 parts, of:—Oxide of lead, 68.33; oxide of copper, 7.36; protoxide of iron, 2.80; chromic acid, 10.13; phosphoric acid, 9.94; water, 1.16; formula,  $3\text{CuO}_2\text{PO}_5 + 5\text{PbO}_3\text{CrO}_3 + 3\text{H}_2\text{O}$ .

**On Diphenyl.**—F. Pfankuch.—Preliminary notice. When phenol-potassium and benzoate of potassa are heated together, benzol and notable quantities of diphenyl are obtained, which, after having been washed with caustic soda and distilled along with aqueous vapour, may be crystallised from boiling alcohol, and thus obtained in pure state. The author continues his researches on this subject.

**Formation of Crystals in the Beads of Borax and Phosphor-Salt when Formed before the Blowpipe-Flame.**—G. Wunder.—A lengthy memoir on this subject, illustrated by several lithographic plates.

*Archives des Sciences Physiques et Naturelles et Revue Suisse*, No. 150, June 15, 1870.

This number does not contain any original papers relating to chemistry, but the following original papers, of which we quote the titles.

**The Grotto of Scé, near Villeneuve (Switzerland).**—H. de Saussure.—A contribution to the history of primitive man.

**Note on the Meteorological Observations made on the Coast of Labrador by Moravian Missionaries.**—Dr. Gautier.

*Monatsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin*, April, 1870.

This number contains the following original memoirs relating to physical and chemical sciences:—

**The Place Thallium should Occupy in the Series of the Elementary Bodies.**—Dr. C. Rammelsberg.—This paper has also been published in the *Berichte der Deutschen Chemischen Gesellschaft zu Berlin*, from which we have before noticed it.

**Relation Existing between Crystalline Form and the Chemical Constitution of Organic Compounds.**—Dr. P. Groth.—A very exhaustive and lengthy memoir, full of formulæ, but not suited for any useful abstraction.

*Moniteur Scientifique*, No. 326, July 15, 1870.

The only original paper relating to chemistry and its applications is a lengthy report on—

**Vinage.**—MM. Béclard, Bergeron, Bouchardat, Gubler, and Wurtz.—By *vinage*, a word which does not admit of being translated by a single word, is understood an operation whereby, either by the addition of alcohol, or, also, of a naturally more strongly alcoholic and deeper coloured wine, some less alcoholic and otherwise less good wines are improved, or, at least, made fit to keep and rendered drinkable. This lengthy report, wherein this subject is fully discussed, winds up with a series of conclusions and propositions for the interference of the authority of Government in a matter which is not only of high importance to wine-growing, but also to all wine-consuming countries. It appears, however, that the root of the evil is partly bad cultivation of the grapes, and partly, also, a perverted taste of the public everywhere as regards the *vin au naturel*—that is to say, the properly-fermented grape-juice. The authors disapprove of the addition of alcohol, even in the shape of brandy, and especially such spirits of inferior description and quality as are often used for the purposes above alluded to.

## NOTES AND QUERIES.

**Analysis of Alloys.**—"T. W." should not have neglected to use a magnet, to separate, by its aid, previous to beginning analytical operation, any steel particles. Instead of using a file, it is better, also, if practicable, to cut, by means of a well-tempered cold chisel, the alloy intended for analysis; and the pieces cut off may, for security's sake, to prevent adhesion of iron or steel, be well rubbed over a hard stone, or with emery paper, and next cleaned with a stiff brush.

**Inflammable Liquids.**—(Reply to "G. G. M.")—Professor Nicklès calls attention to the fact, that when the chloride of sulphur of commerce is mixed with sulphide of carbon wherein phosphorus has been previously dissolved, a fluid is formed, which, though emitting fumes when in contact with air, is harmless, and may be for any length of time kept in well-stoppered bottles; on addition of liquid ammonia, however, or on passing into this liquid a few bubbles of ammonia gas, a most intense combustion at once ensues. This is due to the fact that the ammonia seizes upon the chloride of sulphur, forming chloride of ammonium, whereby so much heat is set free as to cause the combustion of the sulphide of carbon and phosphorus dissolved in it.

## TO CORRESPONDENTS.

\* \* Vol. XXI. of THE CHEMICAL NEWS, containing a copious index is now ready, price 11s. 4d., by post, 11s. 10d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our office, or, if accompanied by a cloth case, for 1s. Subscribers wishing to complete their sets of volumes are requested to apply to the publisher, who will give them information respecting scarce numbers and volumes. Vol. xxii. commenced on July 1st, and will be complete in twenty-six numbers.

**P. H. M.**—The reaction has, we believe, been observed before. You should have an experiment tried on a large scale.

**T. Charters White.**—We are obliged for the report. Shall be glad to have further accounts of the transactions of the club.

**J. Banister.**—We will endeavour to give as much information on the subject as our space will allow. Single numbers of the *Bayerisches Industrie und Gewerbe Blatt* cannot be purchased in England.

**Henry Watts, B.A., F.R.S.**—Our publisher will send you another number.

**R. Mallet, F.R.S.**—We will reply by letter.



# THE CHEMICAL NEWS.

VOL. XXII. No. 558.

## ON THE ADULTERATION OF MILK.

By Dr. A. E. DAVIES, F.C.S., F.L.S.

THE extracts from Dr. Chandler's report on the New York milk in the last number of the CHEMICAL NEWS (vol. xxii., p. 55) raise several points of interest bearing upon the adulteration of milk. As I have devoted considerable attention to this subject, and am at present engaged on an investigation into the quality of the milk supplied in Manchester, I may perhaps be permitted to state very shortly some of my experimental results and the conclusion I have drawn from them.

As to water being the only substance which is employed for adulterating milk I perfectly agree with Dr. Chandler. Carbonate of soda and nitrate of potash are occasionally added, but only rarely, and in very small quantity. I have never met with chalk, sheep's brains, mucilage, sugar, &c., in any sample which I have analysed.

Since water, then, appears to be practically the only substance fraudulently added to milk, it is a matter of the greatest importance that we should be able to detect the presence of added water, and to estimate, at least approximately, its amount. This (at least the presence of added water) Dr. Chandler considers may be done by taking the specific gravity of the milk and by estimating the water it contains by evaporating a weighed sample to dryness. "Pure milk," he says, "varies in specific gravity from 1.023 to 1.032, water being represented by 1.000." And, again, "It is found that good milk generally has a specific gravity of from 1.029 to 1.032. In testing milk, the lower number is selected as a fair gravity for pure milk; and whenever the gravity falls much below this the milk may be considered as containing an excess of water, and consequently poor in quality or adulterated."

Now, according to my experiments, the specific gravity cannot be at all relied on as a test either of freedom from adulteration or of natural richness. I give a single example. A sample of milk of known genuineness recently analysed by me gave the following results:—Casein, 4.26; fat, 6.26; sugar, 5.13; salts, 0.60; water, 83.75; cream (by the lactometer), 17 per cent; specific gravity, 1.0246. It was, therefore, a very excellent sample, and rich in all the solid constituents of milk, especially butter, but had it been judged by its specific gravity, it would have been put down as of very inferior quality. Besides, even supposing the specific gravity to be a reliable test of quality, it gives us no indication as to whether the milk is naturally poor or has been rendered so by the addition of water, and the test, in my opinion, is therefore worthless.

As to the estimation of the amount of water by evaporation, Dr. Chandler says—"A perfectly reliable method, though more laborious, is to actually determine the percentage of water in the milk, by evaporating a weighed quantity and carefully drying the residue at 212° F. If a milk loses more than 88 per cent of water, leaving less than 12 per cent of solids, it may safely be pronounced to be adulterated."

From this view, I totally dissent; the presence of 88 per cent of water is an indication of inferior quality, but is certainly no indication whatever that water has been purposely added. In milk of known purity, examined by Dr. Voelcker, as much as 90.70 per cent of water was found; and this alone shows the untrustworthiness of Dr. Chandler's test—at least, as far as it refers to added water.

It appears to me, that what is wanted is, not a test which will simply tell us whether or not the milk contains

more than the normal quantity of water, without giving any indication whether the water has or has not been added to the milk. If this were all, the estimation of the water, by evaporation, would accomplish it; but, what really is required, is a test which will show if the milk has been purposely diluted with water, and, if so, what quantity of water has been added. Such a test, I believe, we have in the specific gravity of the serum, or liquid portion of the milk, from which the caseine and fat have been removed by coagulating and straining. The gravity of this liquid I have found to be remarkably constant, ranging, in that obtained from genuine milk, from 1.026 to 1.028; and, by carefully ascertaining the specific gravity of the serum of genuine milk diluted with various quantities of water, we may obtain a standard of comparison which will enable us to say, within a few per cents, what quantity of water has been added to any sample of milk that may come under our notice.

## ON THE PRODUCTION OF CERTAIN CRYSTALLINE PHOSPHATES AND ARSENIATES.

By W. SKEY,

Analyst to the Geological Survey of New Zealand.

A GREAT many minerals occur in a natural state, which, in their chemical constitution, their crystalline form, or both combined, have not yet been artificially produced.

It seems very desirable to know, both upon chemical and geological grounds, the conditions necessary for their production, and especially in those forms which they assume in nature.

The metallic phosphates and arseniates—a group of salts which, almost without exception, are only known in the laboratory as gelatinous or pulverulent precipitates,—stand conspicuous among those native minerals, which we have hitherto been unable to obtain by artificial means in their crystalline forms.

I have recently attempted the crystallisation of some of these compounds, with a certain degree of success; and further, in the course of my experiments, I have succeeded in crystallising some phosphates, which, hitherto, have not assumed such a crystalline form, either naturally or artificially.

The process I employ is to add a soluble phosphate, or arseniate, to the solution of a salt of the metal, the phosphate or arseniate of which is required, in the manner hitherto adopted, but only in such limited quantity, that the mixed solution remains acid in its reaction, instead of alkaline, as occurs in the usual method of procedure. If the precipitate is long in appearing, it may occasionally be crystalline; if it comes at once it will be gelatinous, as usual, but in the course of a few hours—sometimes, however, a few days—it will be found crystallised throughout.

The essential features of this process are:—

1st. The maintenance of the precipitated metallic salt in its integrity, which is effected by having the surrounding solution feebly acid.

2nd. Allowing motion to the particles of these gelatinous precipitates, whereby they are amenable to the action of crystallising force; this is accomplished by keeping a little of the same phosphate in a soluble state in contact with them.

In this manner I have succeeded in crystallising the following phosphates and arseniates, which occur in this form in the natural state:—

Phosphate of Zinc,—Hopeite,  $(\text{ZnO})_3\text{PO}_5 + 5\text{H}_2\text{O}$ .

Phosphate of Cadmium.

Arseniate of Zinc,—Kottigite.

Arseniate of Lime,—Pharmacolite.

The following crystallised phosphates and arseniates produced do not occur as such in a natural state:—



*Phosphate of Lime*,  $\text{CaO}_2\text{HOPO}_5 + 3\text{HO}$ . This has the same composition as the amorphous precipitate, produced by adding a triphosphate to chloride of calcium, and then a little ammonia (the precipitate being air-dried); and it is isomorphous with the natural arseniate of lime above, *Pharmacolite*. It crystallises in the form of rhombs, and is acid to test paper.

*Phosphate of Chromium* contains 24 eqs. of water, and has probably the same constitution as Delvauxine, or hydrous phosphate of sesquioxide of iron, the iron being replaced by chromium; its colour is the same as that of chrome-alum, the substance used as the source of the chromium.

*Phosphate of Silver*. Only crystallised from its solution in acetic acid.

*Phosphate of Baryta and Strontia* are also easily crystallised. Those salts having formulæ attached have been analysed.

On reviewing these salts, it will be noticed that the copper, nickel, cobalt, and iron phosphates and arseniates are absent. Indeed, I have not been able to crystallise any of them in this manner; although I am aware that it has been affirmed that phosphate of nickel has been artificially crystallised. But I find that all these metallic phosphates, &c., are capable of forming double phosphates, &c., with phosphates of magnesia and ammonia. The metal may, I think, be looked upon as substituting one equivalent of magnesia in the common ammoniacal phosphate of magnesia.

I also find that phosphate of zinc forms a crystallisable compound with either phosphate of cobalt or nickel. It may be remarked here that the crystalline mineral, *Kottigite*, an impure arseniate of zinc, always contains a little of both these phosphates.

Lastly, it appears that crystalline precipitates are readily produced by contact of soluble phosphates with solutions of the metals cobalt and nickel, if a salt of ammonia is also present. These precipitates contain ammonia, in small quantity, but it appears to be as an essential element in their composition, and not a mere accidental impurity; its quantity has not yet been determined.

The inferences I would draw from these results are:—

1st. That several of the crystalline, simple, natural phosphates and arseniates have not been produced as such directly; but that, in the first instance, *compound* phosphates or arseniates have formed. Magnesia and ammonia, singly or collectively, being the other members of the term. The magnesia and ammonia being afterwards gradually substituted by the metallic oxide. A continued supply of such metallic oxide to the compound phosphate or arseniate would almost certainly effect this, the metallic phosphates and arseniates being more insoluble than the alkaline ones.

2nd. This property of some of the metallic phosphates, &c., of combining with phosphate of magnesia and ammonia to form insoluble compounds, makes it very probable that several of these natural phosphates and arseniates may contain very appreciable quantities of ammonia or magnesia. At any rate, I think, with this property manifested, it would be well to examine rigorously this class of compounds for either of these substances.

These notes are, of course, merely preliminary, there being several points of interest left undiscussed, which can only be properly represented along with the results of future investigations.

## PROPERTIES AND ESTIMATION OF ALBUMEN.

In a recent number, we alluded to a new work on Quantitative Analysis by Prof. Storer. To show our readers the complete and interesting way in which the work is done, we extract from the first sheet the article on "Albumen":—

*Principle I.*—Coagulability by heat.

*Applications.*—Estimation of albumen in alkaline solutions, such as urine and the serum of blood,

*Method A.*—Acidulate the solution slightly with acetic acid, and boil for several minutes. Collect the precipitate on a tared filter, wash thoroughly with warm water, and dry in a current of warm air at  $110^\circ$  or  $115^\circ$ , or, better, *in vacuo*, over sulphuric acid, until the mass ceases to lose weight. Care must be taken that the precipitate is thoroughly dried; for, as soon as the moisture has been driven from its surface, the mass acquires the consistence of horn, and forcibly retains the last portions of the water. The addition of acetic acid to the liquid is essential, in order that the albumen shall be precipitated completely; but no great excess of the acid should be employed, lest some of the albumen be dissolved by it. The precipitate thrown down from solutions thus acidulated is more flocculent, and less apt to clog the pores of the filter during the process of washing than that obtained without the addition of an acid.

To determine albumen in urine, place 50 to 100 c.c. of the clear urine (previously filtered, if need be) in a flask large enough to hold twice as much of the liquid. Heat the liquor gradually, with frequent shaking until the albumen begins to coagulate, at about  $70^\circ$ ; then throw a couple of drops of acetic acid into the flask from the end of a glass rod, and boil the liquor as above described (Neubauer and Vogel).

*Method B.*—Another method of estimating albumen in urine, devised by Heller (*Heller's Archiv. für Chem. und Microsc.*, 1852, p. 266, *et seq.*), is said to afford very accurate results, in spite of being indirect:—Evaporate 10 or 15 grms. of the urine to dryness over sulphuric acid, and weigh the residue. Weigh out another quantity of the same urine in a small flask; acidulate it slightly with acetic acid; boil until all the albumen is precipitated; and, after the liquid has become cold, place the flask upon the balance, and add to it, drop by drop, water enough to replace what has evaporated. Filter the contents of the flask, and evaporate a weighed portion of the filtrate to dryness over sulphuric acid. The difference between the percentage of residue left by the original urine and that obtained from the urine after the separation of the albumen gives the proportion of the latter ingredient.

*Method C.*—For comparing the quantities of albumen in any two different samples of urine, Dr. John Harley has adopted the following process:—Make three small filters from the same sheet of paper; cut down the two heavier to the weight of the lightest, and mark the filters, with a pencil, A, B, and O. Take 1000 grain-measures of urine A; and, having boiled it, pour it, while hot, upon filter A. Treat urine B in a similar way. Wash the contents of each of the filters with warm water until the last traces of adhering urine have been removed. Then pour upon the albumen an ounce of water containing 2 drops of nitric acid, and subsequently wash out the acid with water. The filter marked O is placed, in the first instance, between one of the other filters and the funnel, and is thus equally saturated with urine and acid, and equally washed free from both. All three filters are dried together; and the empty filter is used as a counterpoise in determining the weight of the albumen upon the others.

*Properties.*—Albumen, as it occurs in the state of solution in the animal economy, is combined, not only with water, but with minute quantities of certain saline and alkaline ingredients. When a solution of pure albumen is evaporated, *in vacuo*, at temperatures below  $50^\circ$ , there is left a light yellow, translucent mass of soluble albumen, which may be readily rubbed to a fine white powder. When treated with water, this residue swells up to a jelly, without, however, dissolving to any very considerable extent, unless a small quantity of an alkaline salt be present. By the action of most mineral acids, and of many other chemical agents (sometimes by mere contact with atmospheric air), this soluble modification of albumen is changed to the coagulated, insoluble condition.

Insoluble albumen, when recently precipitated and still moist, is a tough, white, opaque, flocculent solid, insoluble



in water, alcohol, ether, and most acids, when dilute and cold. When left moist in the air, it putrefies. It is somewhat soluble in hot acetic, tartaric, phosphoric, and strong chlorhydric acids. When boiled for a long time with water, it decomposes and dissolves. On being dried, it assumes a yellow colour, and becomes brittle and translucent, like horn. When soaked in water, after drying, it takes up about five times its weight of the liquid, and becomes soft and elastic.

*Principle II.*—Opacity.

*Applications.*—Estimation of albumen in aqueous and saline solutions.

*Method.*—Prepare a little trough of sheet-iron, with glass ends, as follows:—Provide three rectangular sheets of metal, one 7 c.m. square, the others 4 c.m. long by 2.5 c.m. wide. Bend the square sheet into the form of a V-shaped gutter, the upper edges of which are 1 c.m. apart. From each of the smaller sheets cut out wedge-shaped pieces of metal corresponding to the shape of the trough, so that, when the sheets are placed in an upright position, the V-shaped trough may fit into the cuts, and be supported as by feet. Place one of these supports near each end of the trough, and solder them to the trough. Cut out two V-shaped pieces of window glass, fitted to the trough, and cement them into the ends of the trough with Canada balsam, taking care to place the glasses parallel to one another, and to leave a clear distance of 6.5 c.m. between them. The glasses can be cemented the more readily in case a notch or groove be made upon the iron in the beginning to receive them. The metal of the trough should be painted with asphaltum varnish to protect it from rust.

As applied to the estimation of albumen in urine, the process of testing is as follows:—Filter the urine, in case it is not clear, acidulate it slightly with acetic acid, if it be not already acid, and proceed to determine how much the urine must be diluted to fit it for the test. To this end prepare several dilute solutions by mixing measured portions of the urine with water and boil each of the solutions in regular order, until one is found in which the albumen no longer separates in distinct flocks, but only as a milky cloud. It is a liquid thus clouded by the presence of fine particles of suspended albumen, which admits of being subjected to the test of opacity.

The best way of preparing these dilute solutions is the following:—By means of a little pipette graduated to 0.1 c.c., take up 6 c.c. of the urine and transfer it to a 100 c.c. flask. Fill the flask with water to the mark, shake the mixture thoroughly, pour the liquid into a beaker and leave the flask inverted in order that it may drain. Meanwhile pour 6 or 8 c.c. of the diluted urine into a test-tube of 20 or 25 c.c. capacity, heat the liquid to boiling, and afterwards cool it quickly by immersing the tube in cold water. In case the precipitate produced by boiling is so slight that the form of objects placed in strong daylight can be distinguished on looking at them through the liquid, the sample has been too much diluted, and the operator will at once proceed to prepare a more concentrated solution by mixing 12 c.c. of the original urine with water in the 100 c.c. flask. But in case the first solution was not transparent, it may be tested in the trough.

In testing, fill the trough two-thirds full of the cold boiled liquid, and look through the liquid at the flame of a burning candle in a darkened room. Repeat the experiment with other diluted samples of the urine until a point is reached where the shape of the flame cannot be distinguished, and only diffused light can be seen through the liquid, even when the candle is brought close to the trough.

In case the flame is visible through the first solution, the next trial must be made with a solution containing a few more per cents of urine than the first. But if the shape of the flame cannot be distinguished, the liquor of the subsequent trial must be more dilute, and so on methodically, until a liquid is obtained through which the reddish yellow cone of flame can only be seen by

looking with the strictest attention, as if it were in a thick fog. When this point is reached it is only necessary to add a trace more urine (0.1 or 0.2 per cent) in preparing the next diluted sample, in order that the flame may become completely invisible, and the operation be finished.

To find the percentage of albumen, divide the number 2.3553 by the number of c.c. of urine taken to prepare the dilute solution through which the flame could no longer be seen. This number 2.3553, is the mean of 35 experiments by Dragendorff, in which the results of the optical test were controlled by precipitating and weighing the albumen.

*Precautions.*—In looking at the flame, the trough should be held before the eye like a spy-glass, and moved forwards and backwards from a distance of 0.5 metre from the candle close up to the flame, while the instrument itself is continually pressed lightly against the eyebrow. Up to a certain point the last glimpses of the cone of flame can be seen more readily, in proportion as the trough is closer to the candle, but if the flame is too near the liquid, the latter is illuminated by a reddish yellow light, through which the flame is seen less readily. The chamber in which the operation is conducted, should always be dark enough that the yellow light of the candle may overpower the daylight.

In case albumen separates from a diluted liquor in small flocks, the liquor may often be made cloudy and fit to be tested by shaking it violently as soon as the flocks appear. Densely clouded liquids, on the other hand, may be used for preliminary, approximative tests, by mixing them with measured quantities of water. But the results of such experiments must always be controlled by testing samples of urine which have been diluted before boiling. Better results can always be obtained by boiling weak solutions of albumen than by boiling comparatively strong solutions and mixing the cloudy liquor with water.

Instead of the 100 c.c. flask above prescribed, a 50 c.c. flask may be used, but rather more accurate results can be obtained when the larger volume of liquid is operated upon. The pipette employed must be graduated to 0.1 c.c. so that quantities of liquid as small as 0.05 can be measured with it.

The chief difficulty of the process is found in endeavouring to properly acidulate the original urine. Many samples of albuminous urine yield no precipitate, or only a comparatively feeble precipitate on boiling, when too strongly acidulated with acetic acid, and, in like manner, less albumen is obtained by the optical test than by the method of precipitation, in case the acid reaction of the urine is indistinct. It is important that the urine should be kept in a cool place, in order that it may be as fresh as possible when tested.

The original urine need not be filtered unless it contains a distinct precipitate. Urine that is merely cloudy will usually become clear when mixed with much water. Some samples of albuminous urine, however, become cloudy when treated with a few drops of acetic acid or with five or ten times their volume of pure water, and it is precisely this kind of urine which is least readily tested by the optical method. Special care must be exercised in adding acid to such urine, since the presence of a trace of acetic acid in excess may present the appearance of any precipitate on boiling. The cloudy solution (paralbumen) produced on mixing the urine with water, need not be filtered. The mixture should be boiled at once, as if it were clear.

The process is easy of execution, and is said to yield very accurate results, excepting perhaps those kinds of urine which become cloudy on the addition of acetic acid. Ordinarily, no more than five or six of the diluted samples of liquid have to be tested in order to hit the point of obscuration, so that the determination will be finished in the course of half an hour.

The several experiments of the series above mentioned agreed with one another in most instances to the second



decimal place. Only three experiments out of the thirty-five differed more than 0.1, and only 11 more than 0.05, so that 21 of the trials agreed to 0.05 per cent. (Alfred Vogel, *Zeitsch. analyt. Chem.*, 1868, vol. vii., p. 152).

*Principle III.*—Power of rotating the plane of vibration of a ray of polarised light.

*Applications.*—Estimation of albumen in aqueous or saline solutions, such as urine and the serum of blood.

*Method.*—When a ray of polarised light is made to pass through a column of albumen solution enclosed in a tube, it is found that the plane of polarisation is rotated to the left, and that the angle of deviation is proportional to the length of the column of liquid. In like manner, when a tube of any given length is successively filled with solutions containing different quantities of albumen, the angle of deviation is found to be proportional to the amount of albumen in the liquid.

An apparatus, known as Soleil's Albuminometer, used for measuring the rotatory power of albumen, resembles the ordinary Saccharimeter, with the exception that, in place of the Nicol's prism there used as the analyser, a double refracting prism is employed, cut in such manner that only a single image shall appear in the field of vision. An intense white light, such, for example, as that of a petroleum lamp, is needed. The lamp is placed in a blackened box provided with a reflector, which throws the rays of light upon a movable lens, by which they are concentrated before reaching the apparatus.

After the lamp has been lighted and placed in front of the apparatus, put a piece of red glass in front of the polarising prism in the path of the luminous rays, and turn the analysing prism until the luminous image has completely disappeared. The zero point of the apparatus having thus been determined, fill the tube with the solution to be tested, place it in the apparatus, and leave the liquid at rest during some minutes. On again looking into the apparatus it will be seen that, by virtue of the rotatory power of the liquid in the tube, the luminous ray has again become visible, and it will be found that the index of the apparatus must be turned through a certain number of degrees in order to again extinguish the ray. But by counting the number of degrees and minutes between the two points of extinction, it is easy to determine the amount of the rotation and to estimate therefrom the proportion of albumen in the liquor.

It is important to exclude external light as completely as possible; to make several observations with each sample of liquid, and to read the divisions of the circle and vernier carefully, best with a good lens.

In case serum of blood is to be tested, about 1 gram. of sulphate of sodium should be added to each 100 grms. of the liquid, and the mixture filtered immediately, in order to separate blood globules and other suspended particles. The purpose of the sulphate is merely to facilitate the filtration; in the case of urine none of it need be added. The yellowish orange colour exhibited by serum when viewed in thin layers, becomes distinctly red when seen in a long column like that in the tube of the albuminometer. In general, however, this colouration is not intense enough to do any harm; it simply obviates the need of using the red glass, for, like the latter, it only permits the passage of red rays.

In a series of fifty experiments upon blood serum, Becquerel found that the deviation of the plane of polarisation varied between  $4^{\circ} 30'$  and  $9^{\circ}$ , or, on the average,  $7^{\circ} 30'$ . In general, the deviation oscillated between  $7^{\circ}$  and  $8^{\circ}$ . The corresponding quantities of pure dry albumen were from 4.86 to 9.44 per cent. From these and like observations, it has been calculated that, with a column of liquid 20 c.m. long, each minute of deviation corresponds to 0.18 gram. of albumen. (Becquerel, in Robin and Verdeil's *Chimie Anatomique*, 1853, iii., 316.)

*Principle IV.* Specific Gravity.

*Applications.*—Estimation of albumen in urine.

*Method.*—Take the specific gravity of the urine and note the temperature of the liquid when the observation

is made. Acidulate a quantity of the urine with acetic acid, place the liquid in a flask provided with a perforated cork carrying a vertical glass tube, and boil it until all the albumen has separated in the insoluble state. Cool the boiled urine to the temperature at which the specific gravity of the original urine was determined, and take the specific gravity of the clear filtrate. Multiply the difference between the two specific gravities by 210, in order to obtain the percentage of albumen in the sample. In a series of thirteen experiments, the least error was 0.005, and the greatest 0.056. (Lang and Haebler, *Zeitsch. analyt. Chem.*, 1868, vii., pp. 513, 514.)

An article on the estimation of albumen, by gravimetric and volumetric methods, has been published by C. Boedeker, in Henle and Pfeuffer's *Zeitschrift für rationelle Medicin*, Zurich, 1859, v., 320.

## ON THE ANILINE OR COAL-TAR COLOURS.\*

By W. H. PERKIN, F.R.S.

(Continued from p. 54).

ANILINE-BLUE, or "bleu de Lyon," is supplied to consumers as a coarse powder having a coppery lustre, or in alcoholic solutions; it is nearly insoluble in water, and has to be dissolved in alcohol before it is added to the dye bath.

The nature of this blue has been determined by Dr. Hofmann. It is found to contain, like magenta, a colourless base, becoming blue only upon combining with acids. Dr. Hofmann has shown this base to contain  $C_{38}H_{33}N_3$ , and has called it "triphenylrosaniline." Like rosaniline, it becomes colourless when treated with nascent hydrogen, forming a new base, giving colourless salts, as leucaniline. The composition is  $C_{38}H_{33}N_3$ .

The insolubility of aniline blue in water has been found a great drawback to its use, because when employed for dyeing it is thrown out of solution in the dye bath, and then mechanically adheres to the goods, so that it afterwards rubs off.

Mr. Nicholson has, however, discovered a process for rendering this blue perfectly soluble in water. His process closely corresponds to that employed to render indigo permanently soluble. This, it will be remembered, is effected by subjecting indigo to the action of concentrated sulphuric acid, whereby a sulpho-acid is produced.

Mr. Nicholson has found that aniline blue, when treated by a similar process, also forms a sulpho-acid, perfectly soluble in water, and forming with alkalis nearly colourless solutions. These, however, when decomposed by acids, change back to the original blue.

This soluble blue is now much used for silk dyeing, but by dyers it is not thought to be so fast as the normal compound. By some modification of the process just described, Mr. Nicholson has obtained another soluble blue, commercially known as "Nicholson's blue." This is now very extensively employed in Great Britain for wool dyeing, but its application does not appear to be well understood in France and Germany, so that its use there is not so great as in our own country.

If a salt of rosaniline and aniline be heated together, and the process stopped before aniline blue is produced, the resulting product when treated with dilute acid gives a colouring matter which has been called "violet imperial." This was at first supposed to consist of a mixture of blue and magenta, but recent research has shown it to consist of intermediate products. Very large quantities of this colouring matter have been used, but its consumption is now rapidly falling off, owing to the introduction of new violets, about to be described. A few months after the discovery of aniline blue, another colouring matter, called the "bleu de Paris," was obtained by MM. Persoz, De

\* The Cantor lectures, delivered before the Society of Arts.



Luynes, and Salvétat. These chemists found that when aniline was treated with tetrachloride of tin for thirty hours to 180° C. in a sealed tube, neither a red nor a violet, but a very pure blue was produced. This colouring matter is generally described as being identical, or probably identical, with the bleu de Lyon. These blues are, however, widely different in their chemical nature, as the bleu de Paris is easily soluble in water, and crystallises freely in needles of a blue colour, with a coppery reflection. It consists of the hydrochlorate of an organic base, which is precipitated from its solution by alkalis as a purplish blue powder; it dyes silk readily, and retains its blue colour by artificial light. It is remarkable that the discoverers of the bleu de Paris do not seem to have observed its difference from the bleu de Lyon.

I have prepared some of this product with a view to its examination, but hitherto have been prevented from determining its composition. I hope to do so soon.

The bleu de Paris is, unfortunately, difficult to prepare in large quantities, and has never been introduced commercially.

The recognition of the nature of the bleu de Lyon, by Dr. Hofmann, led him to study the action of a class of substances upon rosaniline, known to chemists as the iodides of the organic radicals; this investigation resulted in the discovery of the brilliant colours known as the Hofmann violets, and of which so many shades can be obtained, from a very red purple to a nearly pure blue.

The substances generally used for the preparation of the Hofmann violets from rosaniline are the iodides of methyl and ethyl; the iodide of methyl differs from that of ethyl in a practical point of view, in being rather quicker in its action; it is also more volatile. Both these substances contain a remarkable element called iodine. This body is found in sea-water and sea-weed; its aspect is very similar to that of a metal; one of its characteristic properties is that, when heated, it volatilises and produces a beautiful purple coloured vapour, and here we find how dangerous a little knowledge is when relied upon. When the iodide of ethyl, which, as I have told you, contains iodine, was introduced for the preparation of the Hofmann violets, it was stated in some of our periodicals or daily papers, I do not remember which, that chemists had at last succeeded in fixing the colour of iodine, whereas, the iodine has nothing whatever to do with the colours produced with the iodides of ethyl and methyl, but is simply an instrument in bringing about the change which takes place in their formation; moreover, these colours can be equally produced without using iodine at all. It is unfortunate that the popular reports upon scientific matters are generally so utterly untrustworthy. One of the most remarkable reactions of iodine is the blue violet colour it gives with a solution of starch; this is used as a test for its presence when in the free condition, and is remarkably delicate; it is of no use as a colour, as it is instantly decomposed when heated. To prepare iodide of ethyl, ordinary alcohol is treated with iodine and phosphorus; the operation has to be conducted with care, as iodine reacts upon phosphorus with great energy; usually the alcohol and phosphorus are placed in a retort, and the iodine added very carefully, and in small quantities at the time. The mixture is then distilled, and the distillate mixed with water, which causes the iodide of ethyl to separate as a colourless heavy oil. Iodide of ethyl is very volatile, boiling at 70° C.; it has an ethereal odour, and when pure is colourless and transparent; it contains no less than 81 per cent of iodine. Iodide of methyl is prepared in exactly the same manner as that of ethyl, substituting wood naphtha, or methylic alcohol, for ordinary alcohol; it contains a still larger quantity of iodine than the iodide of ethyl, viz., 89 per cent.

For the preparation of these substances on the large scale, special apparatus has been devised, and sometimes amorphous or red phosphorus is substituted for the ordinary kind; but I shall not have time to enter more

fully into this subject. To produce the violets, Dr. Hofmann heats pure rosaniline with iodide of ethyl, or methyl and methylated spirits of wine, in a cast-iron digester, closed air-tight, with a lid fastened down with screws. A process very similar to this is sometimes employed, and consists in using a salt of rosaniline, caustic alkali, iodide of ethyl, and alcohol. But in Germany the ordinary hydrochlorate of rosaniline is employed with alcohol, or wood spirit and iodide of ethyl, and is found to work very successfully. By employing the rosaniline itself a lower temperature is required for the formation of violet than when using its salts; in fact, I have found that a mixture of iodide of ethyl and rosaniline react even at the ordinary temperature if left in contact for a few days, and produce a red shade of violet.

On the large scale, Hofmann's violet is generally prepared in deep cast-iron vessels, surrounded with a steam jacket, and provided with a lid having a perforation, closed with a screw plug. This lid can be firmly fastened down with screws, the joint being made with a vulcanised india-rubber washer. This apparatus is charged with a mixture of hydrochlorate of rosaniline dissolved in alcohol or wood spirit, and iodide of ethyl or methyl, in proportion according to the shade required. After the apparatus is closed the steam is allowed to enter the steam jacket, and the heating continued for five or six hours; the plug is then removed from the lid of the apparatus, and the alcohol or unused iodide of ethyl distilled off. The resulting product is dissolved in water, filtered, and precipitated with chloride of sodium, but sometimes it is first treated with caustic alkali, to remove all the iodine, so that it may be recovered. Thus obtained, the colouring matter is of a golden lustre if of a blue shade, and of a greenish if of a red shade.

Like all the other colours we have considered, the Hofmann violets are nearly white organic bases, their composition differing according to the shade of colour, thus:—

A red shade is composed of ..	$C_{22}H_{23}N_3$
A red violet shade of .. ..	$C_{24}H_{27}N_3$
A very blue shade .. ..	$C_{26}H_{31}N_3$

The colours of the Hofmann violets are remarkable for their brilliancy, but, unfortunately, they do not resist the action of light so well as might be desired; it is remarkable, however, that the regard for fastness seems to have given way to the desire for brilliancy.

In the early days of coal-tar colours fastness was so much talked about, that when magenta was first introduced it was thought by some that it would not be largely used—how different has it proved to be. Although not very fast upon cotton, the Hofmann violets are sufficiently so for woollen and silk goods, as colours always resist the light better when applied to animal fibres.

In the formation of Hofmann violets we see that rosaniline, when treated with iodide of ethyl, becomes blue, the red being converted into violet; but with mauveine, the base of the mauve, exactly the reverse takes place, the mauveine being converted into a much redder shade with iodide of ethyl. The colouring matter produced from mauveine and iodide of ethyl is commercially known as "dahlia;" the colour is intermediate in shade between aniline purple and magenta. This colouring matter possesses the same character for fastness as the mauve, and also gives the same reactions with acids; unfortunately it is rather expensive, and has, therefore, not been very extensively used.

Lastly, there has been a process proposed for the production of colouring-matters similar to the Hofmann violets, by first converting the aniline into ethylaniline, a base previously discovered by Dr. Hofmann. It is found that by substituting this base for aniline, in some of the processes which have been employed for the manufacture of magenta, the ethyl-aniline yields purple or violet colouring-matters.



This process has been patented by MM. Poirier and Chappat, but the reaction appears to have been first observed by M. E. Kopp. From the great similarity of these colouring matters to the Hofmann violets, I need not enter into any lengthened description of their properties.

Sea-water contains, besides iodine, another remarkable element called bromine; it is a liquid giving off very irritating orange-coloured vapours. This remarkable body yields, with many hydro-carbons, a great variety of compounds. With ordinary turpentine, it acts with great violence; but if the action be moderated by the presence of a large quantity of water, a thick viscid oil is obtained. This body was examined by Mr. C. Greville Williams, who found it to possess the formula— $C_{10}H_{15}Br_3$ .

I have found that this substance, when heated with a solution of magenta in methylated spirits, produces a purple colouring matter of great beauty, commonly known as the Britannia violet; it is very extensively employed for dyeing and printing, and can be produced of any shade, from purple to a blue violet.

The Britannia violet possesses the golden green lustre so common to all the aniline colours. It is easily fusible, amorphous, and very soluble in water.

In my last lecture I showed you the great intensity of the mauve dye. I will now make a few experiments to illustrate the great intensity of some of the colouring matters we have been considering this evening.

I have here some screens of white paper, on which I have dusted a very small quantity of the solid colouring matters,—so small a quantity that I dare say you can scarcely discover its presence. If I now project spirits of wine upon these screens, so as to dissolve the colours, you will see their remarkable intensity.

Let us now consider for a moment the great rapidity with which the discovery of new coal-tar colours followed that of the mauve or aniline purple.

Aniline purple was discovered in 1856; three years afterwards, in 1859, the magenta was introduced. In 1861 we had the aniline blue; in 1863 the Hofmann violet; and in 1865 the Britannia violet. Thus we see that all these colours have not only been discovered, but introduced commercially, in a period of less than ten years.

We have now reviewed the principal coal-tar colours, but there still remain some important ones for our consideration next lecture; and although some of these are not at present largely used, yet it is to them, perhaps, that we may look for the future development of this branch of industry.

(To be continued).

## BURETTE FOR VOLUMETRIC ANALYSIS.\*

By J. BLODGET BRITTON.

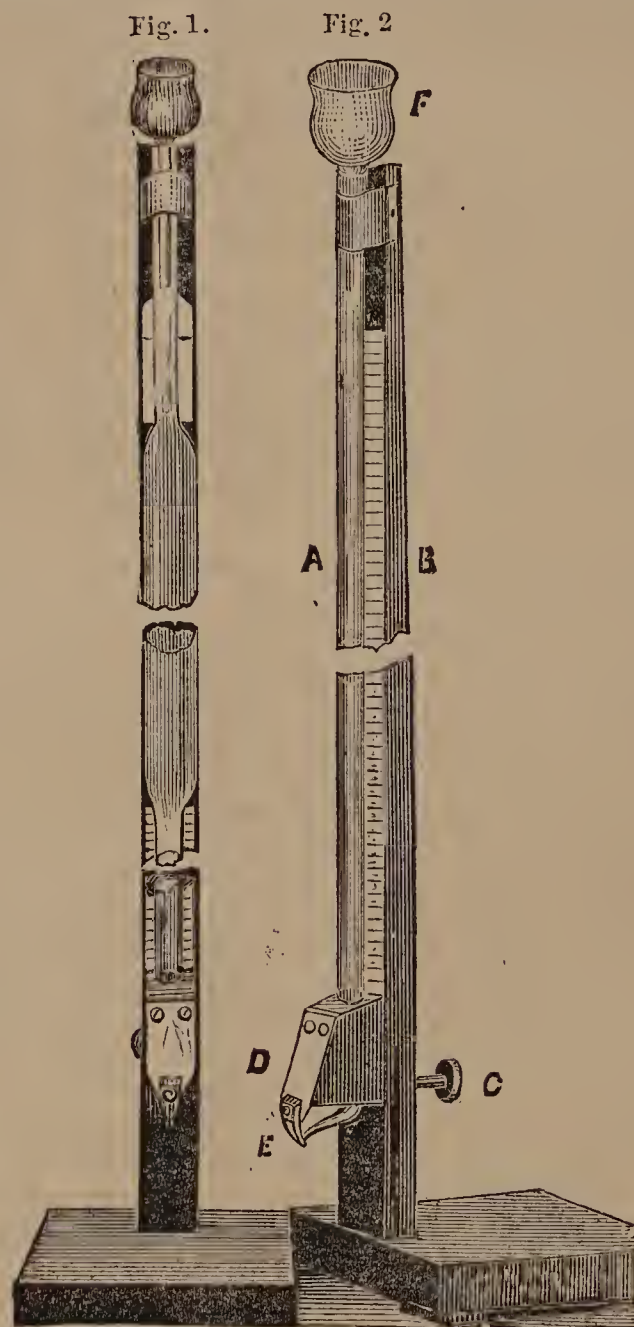
THERE has been in constant use, for the last four years, at the Iron Masters' Laboratory, in determining iron in metals and ores, a very convenient and serviceable burette.

Figures 1 and 2 represent two of the kind, but of different patterns, mounted on walnut wood stands; the former is for metals, and the latter, of smaller capacity, for ores.

Securely fastened to the upright, B, is a graduated tube, A, having its lower part drawn out in the usual manner, but bent outwards at an angle of about  $25^\circ$ . E is a piece of cork rivetted into a sheet-steel spring, D, which presses tightly, by means of the latter, against the vent of the tube. C is a thumb-screw passing through the frame and bearing against the spring.

The tube of Fig. 2 has a capacity of 100 c.c. and is graduated into tenths, or  $1000^\circ$ ; but that of Fig. 1 has a capacity of 150 c.c. and is graduated into 20ths, though only at its lower and narrow part.

*Modes of Operating.*—Place a small narrow-necked funnel in the tube as shown by the figures; pour in the solution to be used until it quite reaches the funnel, and then remove the latter to carry away any floating bubbles; turn the thumbscrew and bring the top line of the solution exactly to the 0 line of the scale; stop the flow, and afterwards touch the point of the cork with a glass rod to take from it any adhering drop. The instrument is then ready



for use. By means of the thumbscrew the dropping may be controlled with *extreme nicety* or *instantly* stopped. Cork, after a little use, becomes quite inert towards permanganate of potash. The occasional application of some pure tallow to the end of the tube and cork will be quite effectual in preventing any of the fluid from running upwards by capillary attraction.

For every day use in the laboratory, as well as for very accurate determinations, I think this burette will find favour.

University of London (First B.Sc. Examination).—The following are lists of the candidates who have passed the recent examinations:—*Pass Examination*: First Division—Philip Herbert Carpenter, University College and Royal School of Mines; Thomas Hick, B.A., private study; John Landor Lowe, King's College; Leonard Lyell, University College; Bernard Mathias Simon Roth, University College; Robert Forsyth Scott, University College. Second Division—Charles Stuart McLean, B.A., Wesleyan College, Taunton; James Monckman, private study; Henry Elthington Price, University and Regent's Park Colleges; William Watson Rowland, B.A., University College.

\* Communicated by Prof. Morton. From advance-sheets of the *Journal of the Franklin Institute*.



## PROCEEDINGS OF SOCIETIES.

### ROYAL INSTITUTION OF GREAT BRITAIN.

*Notes of a Course of Seven Lectures on Electrical Phenomena and Theories.* By Professor TYNDALL, LL.D., F.R.S.

(Continued from vol. xxi., p. 272).

*Electro-Chemistry.—Chemical Actions in the Voltaic Cell : Origin of the Current.*

188. Philosophers suppose matter to be made of elementary parts, called atoms, which are practically indivisible.

189. The elementary atoms can be caused to unite to form compound atoms, which are called molecules.

190. Thus, water is formed of the combination of the atoms of oxygen and hydrogen; common salt is formed of union of atoms of chlorine and sodium; potash is formed by the union of the atoms of potassium and oxygen; the sulphuric acid, also, which we employed to acidulate our water is formed by the union of atoms of sulphur with atoms of oxygen.

191. When, as in our first experiment, two strips of zinc and platinum are dipped into acidulated water, the zinc, as we know, exerts a very strong attraction on the oxygen of the water. When the strips are united, this attraction triumphs; the oxygen unites with the zinc, and a voltaic current is established.

192. The oxide of zinc here formed combines with the sulphuric acid and forms sulphate of zinc.

193. By this removal of the oxide from its surface, the zinc is kept constantly clean, and thus enabled to attract other atoms of oxygen from the surrounding liquid. During this process the zinc gradually dissolves, and as long as this continues the electric current will flow. In fact, it is the constant dissolution of the zinc that maintains the permanent current.

194. The hydrogen of the water, as we have seen, escapes as a free gas from the surface of the platinum, which, unlike the zinc, is not dissolved.

195. We are not yet quite clear as to the precise way in which the electric current is supported by the solution of the zinc, but the following facts and speculations ought to be known to you.

196. When two different metals are brought into contact, with no liquid between them, one of them charges itself with positive and the other with negative electricity. We have here the famous "contact force" which Volta and his followers considered to be the urging power of the voltaic current.

197. But the generation of heat, and the performance of mechanical work, by the mere contact of two metals, would be equivalent to a perpetual motion. It would be at variance with the law which requires, for the production of any power, an equivalent consumption of some other power.

198. It is, however, a fact, that, when two different metals touch each other, the positive electricity resorts, by preference, to one metal, and the negative electricity to the other; the two electricities are, as it were, attracted differently by the two metals.

199. This difference of attraction, however, only causes a momentary re-arrangement of the two electricities, which pass, when the contact is made, into a new condition of equilibrium. As long as the contact continues, this equilibrium is not disturbed; there is no continuous current.

200. We may regard the distinct atoms which enter into the molecules of a compound as charged in a similar manner. For example, the atoms of hydrogen and oxygen, when they unite to form a molecule of water, may be looked upon as charged like the two touching metals. This would be the case if the atoms, like the metals, possessed different attractions for the two electricities.

201. When strips of zinc and platinum are plunged in such a liquid, the positively-charged atom will turn towards the one metal, and the negatively-charged atom towards the other.

202. But, unless the metals touch each other, electrical equilibrium immediately sets in, a constant state of electric tension being set up at the free ends of the two metals.

203. The electricity at the ends may be permitted to flow into a condenser, and may be thus stored up; such a condenser may then be discharged through a covered wire which passes round a magnetic needle, a deflection of the needle being thus produced.

204. Thus, in Davy's experiment with his large voltaic battery, wherewith he charged his battery of Leyden jars, the latter, after having been charged, might be discharged through a galvanometer, a magnetic deflection being thus produced.

205. But the metals, once relieved of their charge, would immediately re-load themselves with electricity, and might be again employed to charge a Leyden battery, and to produce a deflection of a magnetic needle.

206. At no moment during this process the battery circuit would be complete; still we should have a succession of magnetic actions similar to those observed with a closed circuit.

207. In fact, in the closed circuit the solution of the zinc incessantly removes the charged surface of that metal by dissolving it away, and enables the zinc to take a fresh charge; an incessant effort, never fully satisfied, is made to establish electric equilibrium; the incessant renewal of the effort maintains the electric current.

#### *Chemical Actions at a Distance : Electrolysis.*

208. Thus, then, in the cell where the voltaic current is generated chemical action occurs. We have, on the one hand, the decomposition of the water, and on the other the combination of the zinc with the oxygen and the sulphuric acid.

209. But a voltaic current can also produce chemical action at a distance from its place of generation. This discovery, as stated in Note 127, was made in the year 1800, by Nicholson and Carlisle.

210. We cannot decompose water by a single voltaic cell; but, when two or more cells are united to form a battery, the current from such a battery, when sent through acidulated water, tears asunder the united atoms of oxygen and hydrogen.

211. The oxygen is set free at the place where the current enters; the hydrogen is set free at the place where the current quits the liquid. If the direction of the current be reversed, the oxygen and hydrogen instantly change places.

212. It must be clearly borne in mind that the direction of the current, as already defined, is the direction in which the positive electricity moves. Knowing, therefore, the places at which the oxygen and hydrogen are liberated, we can infer with certainty the direction of the current through the liquid.

213. For every volume of oxygen liberated in the decomposition of water by a voltaic current, two volumes of hydrogen are set free.

214. Electro-chemical decomposition is called *electrolysis*; and the compound liquid decomposed by the electric current is called an *electrolyte*.

215. The electric current formed a powerful means of analysis in the famous experiments of Sir Humphry Davy, in 1807.

216. By operating with the current upon ordinary potash, Davy found the base of this substance to be a metal of exceeding lightness, and with an extraordinary appetite for oxygen. When placed on water, it floated on the liquid, and combined with its oxygen. By the heat thus generated, the liberated hydrogen was caused to burst into flame. When a globule of the metal was placed on ice, it burned with a bright flame, and the hole made by the heat was filled with a solution of potash.



217. Soda, treated in the same manner, also yielded a metal resembling that of potash. Thus Davy, by the use of the voltaic current, decomposed the alkaline earths, and greatly expanded our knowledge of chemistry.

218. To obtain these effects, it is necessary to bring the potash and the soda to a state of fusion by heat. In the solid state they are non-conductors of electricity. In fact, the molecules, when rigid, cannot turn in the manner indicated in Note 201. To conduct the current, it is necessary that they should thus turn and be decomposed.

219. When a current is sent through a solution of common salt, it decomposes both the water and the salt. The chlorine of the salt, in company with the oxygen of the water, appears where the current enters the liquid. The sodium of the salt, in company with the hydrogen of the water, appears where the current quits the liquid.

220. Chlorine possesses powerful bleaching properties; and, if the solution of salt be coloured with indigo or litmus, the presence of the chlorine is declared by the destruction of the colour.

221. When a current is sent through a solution of iodide of potassium, the brown substance, iodine, is set free where the current enters, while the metal, potassium, is set free where the current quits the solution. The experiment may be made by moistening bibulous paper with the dissolved iodide.

222. In electrolysis, it is usual to immerse two plates of platinum, or of some other suitable substance, in the liquid to be decomposed, and to send the current from plate to plate. The plate at which the current enters the liquid is called the positive electrode; the plate at which the current quits the liquid is called the negative electrode. Without the liquid, these electrodes would, as we have already learned, charge themselves with positive and negative electricity.

223. But, inasmuch as electricities which attract each other are of opposite qualities, the substance which is liberated at the positive electrode is called the electro-negative constituent, while the substance liberated at the negative electrode is called the electro-positive constituent of the liquid.

224. Thus, in the examples above given the oxygen, chlorine, and iodine are the electro-negative elements; the hydrogen, sodium, and potassium being the electro-positive elements.

225. The terms electro-positive and electro-negative are, however, relative, for a substance may be electro-positive in one combination, and electro-negative in another.

226. If an electric current be conducted through a solution of sulphate of soda, it separates the sulphuric acid from the soda; the presence of the acid may be proved by its turning a vegetable colour red.

227. When nitrate of silver or acetate of lead is decomposed by a voltaic current, crystals of silver, or of lead, are deposited on the negative electrode.

228. The chemical actions of the electric current, some examples of which are here given, constitute what is called electro-chemistry.

229. Electro-plating and gilding, and the electrotype process, are important applications of electro-chemistry. Here, a chemical compound, containing gold, silver, or copper, is decomposed by a voltaic current, the metal being deposited on the surface intended to be coated with it.

230. If the surface on which the metal is deposited have a design engraved upon it, the lines of the engraving are accurately filled by the metal, which, when the deposit is thick enough, may be detached, a perfect copy of the design being thus obtained.

#### *Measures of the Electric Current.*

231. The *tangent-compass*, devised by Weber, consists of a vertical ring of brass or copper, in the centre of which swings a small compass-needle. The ring being placed in the magnetic meridian, the needle is deflected when a current is sent round the ring. The strength of

the current can be proved to be proportional to the tangent of the angle of deflection; hence the name of the instrument.

232. The *voltameter* is an instrument devised by Faraday to measure the strength of an electric current. It consists of a graduated tube, which receives and measures the quantity of gas generated by the current in a given time.

233. The strengths of a series of currents measured by the voltameter are accurately proportional to the same strengths measured by the tangent-compass. Placing a tangent-compass and a voltameter in the same series of circuits, the tangents of the angles observed in the one case are accurately proportional to the quantities of gas generated in the other.

(To be continued.)

## NOTICES OF BOOKS.

*Paris Universal Exposition, 1867. Reports of the United States Commissioners. The Progress and Condition of Several Departments of Industrial Chemistry.* By J. LAWRENCE SMITH, United States Commissioner. Washington: Government Printing Office. 1869.

WE owe to the politeness of the United States Government the receipt of this useful report from the hand of a gentleman of high scientific attainments, who has evidently been thoroughly master of the subjects he undertook to report upon. These subjects are:—the manufacture of sulphuric acids; soda and salts of soda; potash and its compounds; ammonia, baryta, magnesia, and alumina; chlorine, fluorine, manganese, and carbonic acid; industrial production of oxygen, hydrogen, and other elements; manufacture of illuminating gas from coal, and the utilisation of the waste products; stearic acid industry; description of the plates.

This is the bare enumeration of the headings of eight chapters, which are preceded by an introduction, from which we give a quotation. After having briefly referred to the importance of class 44 of the exhibition above alluded to, that class embracing chemical products and chemical processes, the eminent author says:—"Industrial chemistry links itself with every modern art in such an intimate manner, that were we to take away the influence and results of chemistry, it would be almost like taking away the laws of gravitation from the universe; industrial chaos would result in one case, as material chaos would in the latter. No one can paint in too vivid colours the sum of indebtedness the civilised world is already under to the chemist, and no enthusiast can transcend in his wildest speculations what we are yet to realise. The chemical arts in their strictest sense do not simply aid other arts, but they keep in activity a vast amount of capital, and consequently give employment to a large number of individuals, skilled and unskilled." As regards the scope of this book, the author informs us that it is not the province of this work to detail the general character of the articles exposed by different exhibitors, except so far as this or that article may possess some special merit. The author of this work has very successfully brought out an excellent book, from which it is our intention to reproduce some articles in full. The chapters on the manufacture of sulphuric acid, soda, and salts are very complete and concisely written treatises on these subjects.

*The Royal Polytechnic.*—Professor Pepper has lately introduced an amusing entertainment, in which he exhibits the effects, and describes the various modes, of causing ghostly representations of human beings to perform their mysterious movements. His highly interesting lecture, entitled "Sand and the Suez Canal," and a musical entertainment by George Buckland, Esq., are still numbered amongst the attractions.



## CORRESPONDENCE.

### "ROCHAGE" OF CAST-IRON.

To the Editor of the Chemical News.

SIR,—In the CHEMICAL NEWS, vol. xxi., p. 298, you give a brief notice of a paper on this subject by M. H. Caron. This curious phenomenon is well known to those engaged at blast furnaces. The sparks are known by the workmen as "jumpers," and their presence is usually held to indicate an approximation to white-iron. These sparks are absent during the running of grey-iron from the furnace, and only begin to make their appearance when the iron is about No. 4, the usual degree of greyness preferred in South Staffordshire for puddling. The sparks are best observed during the running of white-iron from the furnace, especially if the molten metal is not very fluid, at which times I have frequently observed a vast number produced, particularly in the channel; and sometimes, after the pigs have "set," little jets of sparks are continuously discharged for many minutes, which discharge is accompanied by a hissing sound.

M. Caron's view may probably be correct, but I am inclined to attribute the production of these sparks to the combustion of carbon, and not of iron, as there is an entire absence of the peculiar scintillations displayed by burning iron. Yet one would almost be inclined to believe that grey-iron, which is supposed to contain uncombined carbon, would be more likely to exhibit this appearance than would white- or mottled-iron. Yet, in grey-iron, and even in over-grey, or "Kishy" iron, there is an entire absence of these sparks.

I should be glad to be enlightened by some of your readers upon this curious point—one of the many phenomena of curiosity and interest that are so plentiful at blast-furnaces.—I am, &c.,

T. B.

Stourbridge, July 29, 1870.

## MISCELLANEOUS.

**Quekett Microscopical Club.**—The Fifth Annual General Meeting of this Club was held on Friday evening last, July 22nd, at University College, Gower Street; Peter LeNeve Foster, Esq., President, in the chair. According to the Annual Report of the Committee, which was read, the Club still maintains its popularity and success. It numbers over 500 members, and meets for the prosecution of microscopical enquiry and discussion twice a month throughout the year. Mr. Peter LeNeve Foster in vacating the presidential chair, which he had so ably filled during the past year, delivered his valedictory address, in which he called attention to various open questions in microscopical science, and which were fields well worth the labour required for their investigation, and which, he considered, the members might undertake the study of with pleasure to themselves, and advantage to the world at large. Professor Lionel S. Beale, F.R.S., was elected President for the ensuing year, and Messrs. Henry Lee, F.L.S., Arthur E. Durham, F.R.C.S., Peter LeNeve Foster, M.A., and Dr. Robert Braithwaite were elected Vice-Presidents; while Messrs. Allbon, T. W. Burr, W. M. Bywater, and Charles F. White were elected to fill four vacancies on the Committee. The proceedings then terminated in a *conversazione*.

**Diamonds.**—At a recent meeting of the New York Lyceum of Natural History, Professor T. Egleston, jun., exhibited a fine suite of crystallised diamonds, including about all of the known forms in which this gem is found. They varied in colour, as well as form, and many were curiously distorted, as well as twins. The distortions of

this mineral are very numerous, and of great interest to the mineralogist, as well as dealer in gems. The cube is always opaque. Even if the crystalline form were not well marked, yet a diamond could be told from its peculiar cleavage, which was unmistakable. This cleavage was taken advantage of often in preparing gems for cutting; but sometimes it could not be employed, on account of the shape of the stone, which would be injured in such cases.

**An Improvement in Galvanic Batteries.**—Mr. W. Poole Levison, of Cambridge, Mass., in a letter to the *Journal of the Franklin Institute*, says:—"In the spring of 1869, while making use of a small bichromate of potash battery, I discovered that the addition of nitric acid to the mixture of potassic bichromate and sulphuric acid, contained in its porous cups, conferred upon it the virtue of *steadiness*, without involving the evolution of annoying fumes. For over two months, during last summer, I had in almost constant action a combination of twenty-three large Bunsen cells charged with dilute sulphuric acid and the triple mixture mentioned, and "set up" openly upon the floor of my room. Not only did I work about it with perfect comfort, but left choice brass instruments in its immediate neighbourhood with impunity. Its energy never fluctuated, but after remaining for some time steady, declined, precisely as if the electro-negative plates were bathed in nitric acid only. To a cooled mixture of potassic bichromate solution and sulphuric acid (perhaps preferably in atomic proportions) add *nitric acid*. The proportion of nitric acid may be greatly varied, as its office is merely to transfer oxygen."

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "*Jahresberichte*."

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

*Comptes Rendus des Séances de l'Académie des Sciences*, July 25, 1870.

This number contains the following papers relating to chemico-physical and collateral sciences:—

**Observations on some Peculiarities of the Soil of the Landes.**—M. Faye.—The author describes, in a lengthy paper, a peculiar sub-soil, locally known (in the Départements des Landes, and a portion of that of La Gironde) as *allios*. This is a layer of a peculiarly-agglomerated sand, intermingled with small pebbles, and containing organic matter, as well as oxide of iron. It (the *allios*) is met with at a depth of about 1 metre below the surface; and above, as well as below it (its thickness hardly ever exceeding from 1 to 2 metres, and generally less), is found the loose sand which, in former years, was constantly blown about by the winds, but is now retained in its place by the plantations of the pinadas (*Pinus maritima*). The author ascribes the origin of these *allios* to the fact that, during winter and early spring, these extensive plains (the départements above named are the largest in surface of all the French departments) are inundated by rain-water, which, being slowly absorbed by the soil, forms (at the depth already mentioned), in consequence of the matters it contains in solution, and by evaporation, a cement which causes the agglomeration of the underlying sandy sub-soil. In many parts of the barren moors of the Netherlands and Hanover a similar sub-soil occurs, being locally known as *oerbanken*; they often contain the marsh-iron ore in workable quantity.

**Analysis of a Schistose Rock Impregnated with a Carbonaceous Matter.**—H. Sainte-Claire Deville.—The sample here alluded to is a portion of one which was presented to the Academy by MM. Ravizza and Colomba. The author found that, on being ignited in a closed crucible, this substance loses, as volatile matter, 9.14 per cent. On being further ignited with exposure to air, the quantity of carbonaceous matter burnt off amounts to 0.22 per cent; leaving 90.64 per cent of ash, consisting, in 100 parts, of—Silica, 56; alumina and oxide of iron, 26; lime and alkalis, 18. The mineral, therefore, is simply a schistose rock, impregnated with bituminous matter.



**Recent Observations on the Spectra of Various Types of Stars.**—A letter from the Rev. Father Secchi, S.J., illustrated with diagrams.

**Restoration of a Conically-Shaped Sun-Dial, made so as to Enclose a Fragment of such an Instrument brought from Phenicia.**—A. Laussedat.—In the year 1860, a portion of the French army was sent to Syria, and, while there, M. Renan obtained, from the commander of this expedition, a number of men to assist him in making some explorations in and near a locality now known as Oum-el-Awamid (the ancient Phenician name of this locality, a few miles to the south of Tyre (Gour), is unknown). While engaged in digging about, a stone was found bearing inscriptions, and, moreover, seen to be a portion of a peculiarly-constructed sun-dial. The author of this paper describes, at great length, this instrument, which, in its restored form, is illustrated by a woodcut.

**New Observations on the Variations of the Magnetic Needle.**—M. Broun.—A series of tabulated results on the declination of the needle.

**Mechanical Equivalent of Heat; and on the Electro-Thermic Properties of Aluminium.**—J. Ville.

**Researches on the Bromated Derivatives of Anhydrous Acetic Acid.**—H. Gal.—The author has poured over fused acetate of soda, monobromated bromide of acetyl, ( $C_4H_5BrO_2, Br$ ). The mixture, having been distilled, yielded a liquid which, after having been rectified, boiled at  $245^\circ$ , and was, on analysis, found to contain, in 100 parts—Carbon, 18.4; hydrogen, 1.5; bromine, 61.5. Formula, ( $C_8H_4Br_2O_6$ ); that is to say, bibromated anhydrous acetic acid.

**Volumetric Estimation of Soluble Fluorides.**—P. Guyot.—Since, according to Dr. Nicklès, the fluoride of potassium yields, with perchloride of iron, a white precipitate,  $Fe_2F_{13}, 2KFl$ , the author has based upon this observation a process of volumetric estimation of the soluble fluorides. He employs standard solutions of known strength, which are not, however, specifically described as regards their preparation.

**Fatty Matters contained in the Chyle of Herbivorous Animals.**—Dr. Dobroslavine.—Among the fatty substances discovered by the author, is a mixture of stearic and palmitic acids, oleine, and a fat containing a small quantity of nitrogen.

**Note on the Calcareous Rock containing the Terebratula Diphya in the French Alps from Grenoble to the Mediterranean.**—Dr. Dieulafait.

**Chemical Examination of a Piece of Cement Metamorphised while Immersed in the Water of Bayen de Luchon.**—F. Garrigou.—In the year 1852, a piece of cement (in all likelihood, an hydraulic cement, since some of it was used to line the cavities of the rock through which the water of the above-named spring runs), of the size of two fists, was placed in a reservoir constantly filled with the warm ( $64^\circ$ ) water of the spring alluded to. The original cement contained a large proportion of carbonate of lime. The metamorphised material was found to have taken up a large quantity of silica, some fluorine, and organic matter.

**Contemporaneousness of Man, with the Large Ursus Spelæus, and the Reindeer in the Caverns of Gargas (Haute Pyrénées).**—F. Garrigou and De Chasteigner.

**Application of Thin Sheet-Lead, instead of Lint, in Wounds.** Dr. Burggræve.—The author states that lead feels soft and cool to the wounded parts; its use entirely supersedes that of lint. The formation of a very thin layer of sulphuret impedes putrefaction and the development of small organisms. When once the wound has been dressed with lead, it may be washed as often as desired with water, without the necessity of removal of the dressing. Lastly, the use of lead renders summary operations frequently unnecessary.

**Preparation of Aluminium-Ethyl.**—Dr. Cossa, in a very short letter to M. H. Sainte-Claire Deville, says that, according to his researches, aluminium acts, at the ordinary temperature, upon iodide of ethyl enclosed in sealed tubes. Aluminium-ethyl was also prepared by the author by causing aluminium to act upon stannethyl.

#### Programme de la Société Hollandaise des Sciences de Haarlem, Année 1870.

On the 21st of May last, the general yearly meeting of this scientific Society was held at Haarlem. The Huyghens medal (see CHEMICAL NEWS, vol. xx., p. 57) has been granted to M. Rudolph Julius Emanuel Clausius, Professor of the University of Bonn, as principal founder of the dynamic theory of heat. Dr. A. W. H. Kolbe, of Leipzig University, was elected foreign member of this Society. Among the questions open for competition, and to be answered on or before the 1st of January, 1872, we notice the following:—The mode of origin and the part *wax* plays in living plants; to be investigated by anatomical and micro-chemical researches. To elucidate, by original research, the history of the development of certain malformations and excrescences produced upon oak-trees by various gallicolous *Hymenopterous* insects; it is desired that, in this investigation, the influence of the insect in its successive phases of development, as well as the morphological, anatomical, and chemical changes the part of the plant affected undergoes, shall be duly taken into consideration. Critico-historical exposition of the discovery and development of spectrum analysis, and its applications to chemistry and astronomy. The mathematical theory of the induction coil (*bobine*). Since the value of the constant aberration, as deduced by Delambre from the eclipses of Jupiter's first satellite, differs from the aberration as resulting from later astronomical measurements, and since the cause of that differ-

ence is not yet well ascertained, it is desired that a collection be made of all the observations made on the eclipses of Jupiter's first satellite which are recorded in and disseminated through different periodicals, and also that, from these data, a new determination of the constant value of aberration be made. A new series of researches on the influence which the different colours of the spectrum have upon the so-called respiration of the green parts of plants. New series of investigations and researches to be made of the organic bases contained in the genus *Cinchona*. The Society's gold medal, and, in addition thereto, a premium of £25, will be given to him who finds, either by means of kites or captive balloons, the means of elevating, to great height in the sky, meteorological instruments, so that they may be kept in that position for at least twenty-four hours. The Society's gold medal will be granted for the production of any self-acting and accurately self-registering meteorological instrument—thermometer, barometer, hygrometer—suitable to be fixed to a kite or a captive air balloon for at least twenty-four hours, and so constructed (*viz.*, the instruments) as to give satisfactorily the results of the state of the atmosphere at great height. The two questions open for competition to January, 1873, relate to botany and zoology. The Society desires to recommend to the competitors for prizes to omit, in their answers to questions, any matters not directly relating to the proposed question. It is, moreover, desired, that whatever be sent into the Society should be worked out with accuracy, and that every proposition be well defined and demonstrated, and not mixed with vague theories or badly-digested and not well established facts. The memoirs sent in must on no account whatever be written in the handwriting of the authors themselves, as in this case, even were these memoirs worthy of the award of the medal, no award could be made, according to the Society's rules. The envelopes added to the memoirs sent in, and appended thereto by a peculiar mark, and containing the author's name, will, in case no award is granted, be burnt unopened. The memoirs to be sent in for competition may be written in Dutch, French, Latin, English, Italian, or German languages, at the author's option, provided, in the case of the German language, the italic, and not the peculiar German mode of writing, be used. All such documents, and the envelopes appended thereto, and just alluded to, should be sent, carriage or postage paid, to Dr. E. H. von Baumhauer, the Secretary of the Society, residing at Haarlem, North Holland, Netherlands. The prize offered for a satisfactory memoir or answer to each of the proposed questions is the Society's gold medal, value £12 10s., bearing the author's name and the year of issue; or, if the author desires it, the full money-value of the medal. In some cases, it is left to the umpires of the awards to grant an additional award of the value just mentioned. The competitor to whose memoir a prize shall have been awarded may not, without the express consent and authorisation of the Society, print or publish, either in whole or part, separately or in any periodical, the memoir to which the prize has been awarded.

#### Zeitschrift für Chemie von Beilstein, No. 11, 1870.

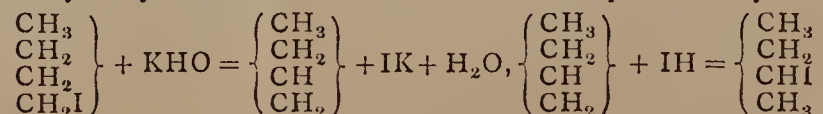
This number contains the following original papers and memoirs:—

**The Isomeric Toluolsulpho Acids.**—A. Wolkow.—After referring at great length, to the preparation and purification of the compounds, and their separation from each other, the author describes—*a*, or toluol-parasulpho acid,  $C_7H_7(HSO_3)p$ , and the potassa-salt of that acid,  $C_7H_7(KSO_3) + H_2O$ , which is obtainable in large six-sided prismatic crystals; the chloranhydride of the toluol-parasulpho acid,  $C_7H_7(SO_2Cl)p$ ; the amide of toluol-parasulpho acid,  $C_7H_7(SO_2NH_2)p$ ; paratoluide of toluol-parasulpho acid; meta-nitrotoluol-parasulpho acid and its chloranhydride and amide; paratoluide—



toluol-metasulpho acid; the amide of the toluol-metasulpho acid. All these, and some derivatives thereof, are described at very great length, but so as to render any further useful abstraction impossible.

**Conversion of the Primary Normal Butyl-Alcohol into the Secondary Butyl-Alcohol, or Methyl-Ethyl-Carbinol.**—Dr. A. Saytzeff.—By heating the iodanhydride of the normal butylic alcohol with an alcoholic solution of caustic potassa, the author obtained butylen, which was combined with HI; the ensuing compound was converted into a corresponding acetic ether, and this into an alcohol which boiled at about  $100^\circ$ . The oxidation of that alcohol yielded methyl-ethyl-keton and acetic acid, while the alcohol was proved to be methyl-ethyl-carbinol. These reactions are represented by—



**Formation of Chloride of Carbon,  $C_2Cl_6$ , from Acetic Acid.**—H. Hubner and F. C. G. Muller.—After referring to the researches of Dr. Samosadsky, the authors describe, at length, a series of experiments and preparations, from which they infer that acetic acid, when acted upon by the chloride of phosphorus, exchanges its oxygen for chlorine; so that, as a final result of this reaction, the chloride of carbon is obtained.

**Composition of Sugar-Cane.**—O. Popp.—The author has analysed fresh sugar-cane, after pulling the leaves off. Martinique and Guadeloupe cane (America) contains, in 100 parts—Water, 72.22; cane sugar, all crystallisable, 17.80; glucose, 0.28; cellulose, 9.30; salts, 0.40. African canes: Middle Egypt (Cairo) contains, in 100 parts—Water, 72.15; cane sugar, 16.0; glucose, 2.3; cellulose, 9.2; salts, 0.35. Upper Egypt—Water, 72.13; cane sugar, 18.1; glucose, 0.25; cellulose, 9.1; salts, 0.42. The author adds, that the quantity of sugar above

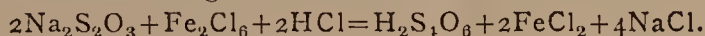


quoted is an average quantity, since its percentage may reach as high as 20, while the glucose may be entirely absent, and is so in some kinds of cane (different species of the plant), and with good cultivation in all kinds. Sugar-cane dried at 100°, previously deprived of its leaves, yielded from 3.8 to 4.3 per cent of ash; the dried leaves yield by themselves from 8.0 to 8.5 per cent of ash. The composition of the ash of the American cane, without leaves, is, in 100 parts—Potassa, 7.66; soda, 6.45; lime, 12.53; magnesia, 6.61; oxide of iron, 0.56; silica, 43.75; phosphoric acid, 5.45; sulphuric acid, 16.53; chlorine, 0.21—together, 99.75. Ash of the leaves, in 100 parts—Potassa, 10.65; soda, 3.26; lime, 8.19; magnesia, 2.45; oxide of iron, 0.85; silica, 65.78; phosphoric acid, 1.25; sulphuric acid, 2.18; chlorine, 1.65; carbonic acid, 3.55—together, 99.81.

**Qualitative Detection of Sulphurous Acid and Volumetric Estimation of Iron.**—O. Popp.—When an acid solution of perchloride of iron is added to a solution of hyposulphite of soda, there is obtained a very deep brownish red colouration, soon passing to amethyst red, and then disappearing, leaving a colourless fluid. The disappearance of the colouration is instantaneous at from 40° to 45°. The author advocates the application of this colouration as a qualitative test for hyposulphites, as well when by themselves as when mixed with sulphates or sulphites. The latter also reduce iron, but without the appearance of the colouration alluded to, which is due to the conversion of the hyposulphurous acid into tetrathionic acid by the action of the acid perchloride of iron. This reaction, which is analogous to the action of iodine upon hyposulphite of soda, takes place according to the formula—



or, rather, because a free acid has to be present; and free tetrathionic acid is formed according to the formula—



The author mentions briefly the volumetric estimation of iron as proposed to be carried on by Dr. A. C. Oudemans, which process is based upon the reaction alluded to; but since we intend to give the paper thereupon in full, we abstain now from quoting the brief description of that process as given here.

**Researches on Mesitylen-Sulpho Acids of Mesitylen.**—H. Rose.—After referring briefly to Dr. Jacobsen's investigations on this subject, the author treats on the action of bromine upon mesitylen-sulpho-acid, stating that that haloid acts upon the acid, even when care is taken to cool the mixture, most energetically; but, by a circuitous process, the brom-mesitylen-sulpho acid was obtained. In free state, that acid, a solid body, is very soluble in water, alcohol, and ether, from which latter fluid it is most readily obtained in crystals. This substance is very deliquescent, but its salts are difficultly soluble in water. The author describes the baryta, lead, potassa, soda, and copper salt, the formula of the latter being—



The author then treats on the preparation of brom-mesitylen-sulpho acid from monobrom-mesitylen, the body thus obtained, and its salts, being found to be identical with those previously alluded to; researches and experiments on the action of fuming nitric acid upon mesitylen-sulpho acid, and the action of fuming sulphuric acid on the products resulting from the action of nitric acid, are in course of execution.

**Glycerine Compounds, and a New Kind of Formation of Allylic Alcohol.**—H. Hubner and C. Muller.—The contents of this paper relate chiefly to some rectifications needed in the results of the experiments of Professor Berthelot on this subject, for the authors, while repeating his (Berthelot's) experiments, found very great discrepancies in the results, although exactly carrying out the instructions given by the *savant* alluded to.

*Moniteur Scientifique*, No. 325, July 1, 1870.

This number does not contain any original memoirs or papers related to chemistry, but we meet here, under the title—

**Acoustical Attraction and Repulsion.**—J. Guyot.—A reproduction of a paper from a defunct French scientific periodical, here reproduced to show that the experiments Dr. H. Schellbach, in Germany, and Dr. Guthrie, in London, are busy with on this subject were already, to a great extent, made in 1832 by the author.

*American Journal of Pharmacy*, July, 1870.

This number contains the following original papers and memoirs relating to chemistry, besides several excellent strictly pharmaceutical papers:—

**Vaccinine, a Crystalline Principle Extracted from the Leaves of the Cowberry (*Vaccinium vitisidæa*, L.).**—E. Claussen.—The amount of vaccinine in the shrub is about 1 per cent; it forms long acicular crystals, of somewhat bitter taste and devoid of smell. This substance is scarcely soluble in ether, better so in cold water and alcohol, but best of all in boiling water; a saturated solution of this substance in the latter yields, on cooling, a solid mass. When the crystalline substance is heated, it melts to a clear liquid. It is not precipitated by either sub-acetate of lead or tannin, is neutral to test-paper, and contains no nitrogen.

**Simple Apparatus for Rapid Evaporisation at Limited Heat, under Reduced Pressure, without the Use of a Pump.**—A. B. Prescott.—The author describes, at some length, the use of ordinary

distilling apparatus for the production and maintenance of an approximate vacuum over liquids during their evaporation, in cases where the heat of 120° to 150° F. may be applied.

**Report of Professor C. F. Chandler to the Metropolitan (New York) Board of Health, on Various Hair Tonics, Washes, Cosmetics, and other Toilet Ingredients.**—The author, by direction of the Board of Health, has investigated the composition of the following articles, viz.:—Hair tonics, washes, and restoratives; lotions for the skin; enamels; white powders for the skin. Of the substances named in the first category, sixteen were examined, all of which, with but one exception, were found to contain lead, generally in the form of the acetate or sugar of lead. No. 11 among these samples is Mrs. S. A. Allen's "world's hair restorer," of 198 and 200, Greenwich Street, New York. One fluid ounce of this cosmetic (largely advertised) contains—Lead in solution, 5.25 grains; lead in the sediment, 0.31 grains—total, 5.57 grains. The one sample free from lead was an ammoniacal solution of nitrate of silver, containing 4.78 grains of the nitrate in 1 fluid ounce. Of the lotions for the skin (six different samples were analysed), only one was made up with injurious metals—viz., an American compound, known as "Perry's moth and freckle lotion," containing, to the fluid ounce—Corrosive sublimate, 3.61 grains; and crystallised sulphate of zinc, 4.25 grains. Among the enamels for the skin, seven different samples were tested, among which, three containing from 108.94 to 190.99 grains of white-lead in 1 fluid ounce; other samples were found to contain oxide of zinc. The white powders for the skin were found to be chiefly made up of carbonate of lime and magnesia, clay, and French chalk; and as far, therefore, as these materials are concerned, are harmless, except in so far as their application may interfere with the healthy action of the skin.

**Ambrosine.**—C. U. Sheppard.—With this name is indicated a new fossil resin found in the phosphate bed of South Carolina. The colour of this material is brown; fracture, conchoidal; lustre, resinous; sp. gr., slightly greater than that of water; feebly translucent; becomes strongly electric by friction; melts, at about 460° F., into a clear yellowish liquid; gives off some succinic acid on being heated; is very combustible; is soluble in oil of turpentine, alcohol, ether, and chloroform, also in solution of caustic potassa; and is not decomposed by strong mineral acids.

*Archives Néerlandaises des Sciences Exactes et Naturelles*, vol. v., parts 1–3, inclusive.

These numbers contain the following original papers and memoirs:—

**Temperature of Volatilisation; and on the Specific Heat of Solid and Liquid Bodies.**—J. A. Groshans.—This very lengthy essay is an algebrico-physical treatise on this subject.

**Simple Method for the Exact and Precise Comparison of Measures of Length.**—F. J. Stamkart.—This excellent paper, illustrated with several engravings, was originally written and published in Dutch, as far back as the year 1839, but is here reproduced in French at the suggestion of Professor F. Kaiser, partly in order to prove to M. Steinheil, of Munich, that the author (M. Stamkart) had, some thirty years ago, already invented what the German *savant* has lately described under the name of *fuhrspiegel*, and chiefly because M. Stamkart's invention is of the highest importance just now for the purpose of aiding the exact reproduction of the standards of length (*étalon prototype*) of the metre.

**Determination of Small Differences of Length, the Measurement of Minute Thicknesses in Small Objects, and the Observation of Very Small Displacements in Large Objects.**—F. J. Stamkart.—Illustrated with several engravings.

**Morphology of the Shoulder-Muscles of Birds.**—Emil Selenka.

**Movements of the Eye Illustrated by means of the Phenophthalmotrope.**—F. C. Donders.

**New Materials to serve for the Knowledge about Cycadææ.**—F. A. W. Miquel.

**Contributions to our Knowledge of the Flora of Japan.**—F. A. Miquel.

**Specific Gravity of Alcohol, and of Mixtures of Alcohol and Water.**—Dr. E. H. von Baumhauer.—This paper, is written chiefly in order to review the labours of M. D. Mendelejeff\* on this subject, and compare the results obtained by him with those the author obtained while exhaustively investigating this subject some ten years ago. The author fully and satisfactorily proves that the strong criticism of M. Mendelejeff against his (Dr. von Baumhauer's) labours on this subject is quite erroneous; and he also, by a new series of very accurately-performed experiments, fully confirms the results before obtained by him. The sp. gr. of absolute and perfectly pure alcohol is, at 15°, equal to 0.7940, water at its greatest density being taken as unit.

**New Species of Argostemma: a Contribution to the Flora of the Netherlands' East Indies.**—W. F. R. Suringar.

**Two New Species of Crustaceæ Living as Parasites on Fishes (Epichthys and Ichthyoxenos).**—J. A. Herklots.—With a series of engravings.

**Observations on the Character and Formation of Suber and Liber in Dicotyledonous Plants.**—N. W. P. Rauwenhoff.

**On the Crystallites.**—H. Vogelsang.—A crystallo-genetic essay illustrated with engravings.

\* *Poggendorff's Annalen*, vol. cxxxviii., pp. 103–141 and 230–279.



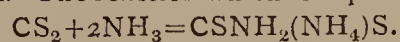
Specific Heat of Solid and Liquid Bodies.—J. A. Groshans.—Second essay on this subject.

Place to be Assigned to the Chiromys in the Natural Classification of Animals.—C. K. Hoffmann and H. Weyenbergh, jun.

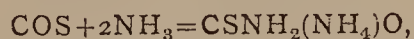
Results obtained by the Mathematical Study of the Movements of the Eye.—G. F. W. Baehr.

The Petrified Forest of Cairo, the Cliffs of Black Earth and Broken-up Crockery Ware of Lower Egypt, and the First Cataract of the Nile.—H. Hartogh Heys van Zouteveen.

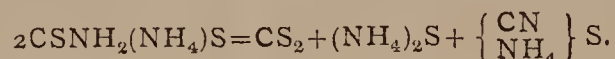
Synthesis of Sulphocyanate of Ammonium.—H. Hartogh Heys van Zouteveen.—When a current of dry ammonia gas is passed through sulphide of carbon at the ordinary temperature of the air, no reaction whatever is stated to take place, according to M. Berthelot, but the author of this paper says—When dry ammonia gas is made to pass through sulphide of carbon, that liquid becomes first yellow, and, after depositing a brick-red coloured substance, becomes colourless again. This deposit, having been separated and dissolved in water, yielded, on partial evaporation of that liquid, some sulphide of carbon and sulphide of ammonium, which volatilised, while a small quantity of sulphur was deposited. The remainder of the solution was found to contain sulphocyanate of ammonium, readily recognised by its behaviour with chloride of iron. The reaction which took place is the following;—



Likewise—



that is to say, first, sulphocarbamate of ammonium was formed, and this was split up, by the heat applied to its aqueous solution, into sulphide of carbon, sulphide of ammonium, and sulphocyanate of ammonium—



Observations on Holtz's Electrical Machine.—V. S. M. van der Willigen.

Volumetric Estimation of Iron by means of Hyposulphite of Soda.—A. C. Oudemans, jun.—This lengthy essay is chiefly written with the view to prove that the critical remarks on the author's former papers on this subject, made by Dr. Mohr, are entirely imaginary. The author has slightly modified his method of operating; but it appears, after all, that, for all practical purposes, his method, as at first described, was found to answer well, as indicated, also, by no less an authority than Dr. Fresenius, not to mention others beside. This paper contains, moreover, the tabulated results of a new series of experiments, which leave nothing to be desired for accuracy.

Observations on Parthenogenesis with Lepidoptera.—H. Weyenbergh, jun.

Origin and Development of the Periphyllus Testudo.—H. C. Ritsema.

Abstract of a Report on the Purification of the Air of Hospitals by means of the Combustion of Organic Germs.—J. van Geuns and E. H. von Baumhauer.—An abstract of a report on M. Woestyn's proposal to purify the vitiated air of hospitals, previous to its exit into the atmosphere, by means of a high temperature (or even red heat), from any organic and organised germs it might happen to contain. The authors point out that M. Woestyn's method, as proposed, is not complete, and not such as to fully carry out the object desired.

*Revue Hebdomadaire de Chimie*, July 7, 1870.

Manufacture of Carbonate of Baryta and of Artificially-Made Barytic Stones.—M. Allain.—The author employs the native sulphate of baryta of commerce, converts it as usual, first, into sulphuret of barium, and this (by the aid of chloride of zinc) into chloride of barium, and this again (by means of carbonate of soda) into carbonate of baryta. The artificially-made stones consist of a mixture of 2 equivalents of silica, 3 of silicate of alumina, and 10 of carbonate of lime. This mixture having been first ignited, is ground to powder, and there is then added 3 equivalents of powdered carbonate of baryta. This dry mixture is passed through a sieve, and kept in closed vessels free from contact of air. When wanted for use, the mass is mixed with water, and next moulded into the desired shape, yielding, on drying, a very hard, stony material.

*Bulletin de la Société d'Encouragement pour l'Industrie Nationale*, No. 209, May, 1870.

This number contains the following original papers and memoirs relating to chemistry and allied sciences:—

Report on a Water-Meter Constructed by M. Chameroy fils.—M. Tresca.—The author of this paper, which is illustrated with engravings, speaks in very high terms of the accuracy and efficacy of this piece of machinery, the action of which is based upon an entirely new principle, the maker having succeeded in rendering the flow of the water dependent upon a difference in pressure between the main- and service-pipes, while this value has been rendered effectively invariable. This paper is a valuable contribution to our knowledge about water-meters generally.

Report upon an Annular Kiln, Continuously Working, for Bricks and Pottery.—V. Bois.—This paper, also, is illustrated with engravings, and treats of the construction of a peculiar kind of brick and pottery kiln, the invention of a M. Hoffmann, at Berlin. It appears that this contrivance is suitable, not only for firing bricks, but also for the burning of lime, cement, pottery-ware, and plaster of Paris.

Report on M. Jordan's Work on the Iron Industry.—M. Lamy.—It appears that M. Jordan's published work is one of the most complete hitherto issued on this subject.

Report on the New System of Conveying Beet-Root Juice, according to M. Linard's Proposal.—M. A. Payen.—The author treats of a contrivance whereby the beet-root juice is pressed from the roots, and carried, by cast-iron pipes, to the beet-root sugar-works. The roots are pulped, and the juice expressed, so to say, on the very spot where the roots are grown; and the juice is conveyed, by pipes laid underground (as are gas- and water-pipes) and along the roads, to the beet-root sugar-works, while a portion of these pipes are used in summer time to carry and force up fresh water to the farms.

*Cosmos*, July 23, 1870.

Coal Formation of the Lofoden Islands (Norway).—S. Meunier.—It appears that, in the Island of Andø, one of the Lofoden group, a seam of coal has been discovered, which, in physical and other properties, bears a resemblance to the well-known boghead, but the thickness of the layer is irregular, and does not, as far as has been ascertained, exceed 20 inches. The diameter of this coal basin is about 2300 metres.

Meteorite of Lodran.—Dr. Tschermak.—This stone contains, in 100 parts—Nickeliferous iron, 32.5; olivine, 28.9; bronzite, 31.2; magnetical pyrites, 7.4. The author gives, at length, the separate analysis of each of the enumerated mineralogical constituents.

Unlimited Filtration of River Water.—Dr. Burg.—A lengthy description of an arrangement for filtering the water of rivers, but only, it appears, intended to be applied where no navigation is carried on.

Prevention of Boiler Incrustations.—V. Bois.—The author employs the agglutinated offal of hoofs and horn for this purpose, and states that very satisfactory results have been obtained by the application of this substance, and that even old incrustations are rendered friable, so as to be readily removed.

*Revue des Cours Scientifiques de la France et de l'Etranger*, July 30, 1870.

This number does not contain any original papers or memoirs directly relating to chemistry or collateral sciences, but it contains—

The Backwardness of Science among the Ancients.—C. von Littrow.—Being his inaugural speech at the University of Vienna. This paper contains several noteworthy facts, among which we mention the following:—The use of the compass in navigation was known to the Chinese in the fourth century; the Arabs made the Europeans acquainted with India in the eighth century, and the crusades of the tenth century brought numbers of Europeans to the eastward, yet the use of the compass was not introduced into Europe until the twelfth century.

Death of M. Daniell Dollfus Ausset.—The town of Mulhouse has just lost a very celebrated citizen, the gentleman just named, brother of the celebrated manufacturer, M. J. Dollfus. The deceased had left the pursuits of industry to devote his time entirely to science, and especially to geology and mineralogy. He was one of the most expert explorers of the alpine glaciers, and his extensive researches in science associate his name with those of Agassiz, Des Desor, and Des Martius. The deceased was a man of great wealth, and was highly respected by all who were acquainted with him.

## NOTES AND QUERIES.

Waterproofing.—I shall esteem it a favour if you can inform me of the most approved composition for rendering cloth waterproof; I mean such as is used for tarpaulins of a light colour.—M. A. S.

Carbolic Acid.—"Fitzetienne" would be glad to know of any tolerably accurate method of determining the percentage of carbolic acid in dead oils and other liquids containing small quantities of the acid.

## TO CORRESPONDENTS.

\*\* Vol. XXI. of THE CHEMICAL NEWS, containing a copious index is now ready, price 11s. 4d., by post, 11s. 10d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our office, or, if accompanied by a cloth case, for 1s. Subscribers wishing to complete their sets of volumes are requested to apply to the publisher, who will give them information respecting scarce numbers and volumes. Vol. xxii. commenced on July 1st, and will be complete in twenty-six numbers.

Carbon.—We cannot do better than refer you to our advertisement pages.

J. Wallace Young.—In our next.

A Subscriber.—Messrs. Kent and Co., Paternoster Row, are the publishers.

Arthur E. Davies, Ph.D.—We are obliged for your communication.

J. Carteghe.—The alteration has been made.

Bollman Condry and Co.—Received.

W. H. Wilson.—Forwarded.



# THE CHEMICAL NEWS.

VOL. XXII. No. 559.

## ON THE COMBINATIONS OF CARBONIC ANHYDRIDE WITH AMMONIA AND WATER.\*

By EDWARD DIVERS, M.D., F.C.S.

THE following paper contains an account of some investigations upon the chemical reactions and combinations with each other of carbonic anhydride, ammonia, and water:

### *The Ammonium Carbonates.*

There are certainly three combinations of ammonia and carbonic anhydride, into the formation of which water enters in sufficient relative quantity to allow of their being represented as ammonium-salts of carbonic acid—the normal, the half-acid, and the acid carbonates.

1. *The Normal Carbonate.*—This salt can be prepared by acting on the commercial "carbonate of ammonia" with solution of ammonia. Being only sparingly soluble in the presence of much free ammonia, the normal carbonate is easily obtained in the solid state by using the ammonia in sufficient excess. When the solid commercial salt is treated with strong solution of ammonia, the normal carbonate is left as an indistinctly crystalline, mealy solid; when a concentrated aqueous solution of the commercial carbonate is treated with ammonia gas, the normal salt is thrown down as a crystalline precipitate; when a warm saturated solution of the commercial carbonate in dilute solution of ammonia is set aside, the normal salt is obtained in large crystals; lastly, when a weaker ammoniacal solution of the commercial salt is mixed with alcohol, the normal carbonate is deposited. It can also be formed by allowing a warm concentrated solution of ammonium carbamate in water, or, preferably, in solution of ammonia, to crystallise. But the most interesting way in which it can be prepared is that of treating the same quantity of water a great number of times with fresh quantities of the commercial carbonate at a gentle heat, and allowing the solution to cool and deposit crystals after each addition, when the mother-liquor from the last crop of crystals which forms on cooling will yield large crystals of the normal carbonate on being set aside for some days.

Dalton has given two methods by which he obtained the normal carbonate—one of which was by distilling the commercial carbonate, and collecting the first product of the distillation before it had been exposed to the air; and the other, by adding to a warm saturated solution of the commercial carbonate sufficient ammonia-water to raise the proportion to the proper degree, when, on cooling, it was copiously precipitated. The latter of these methods only succeeds, however, when the ammonia is added in good excess; concerning the former of them, it is to be observed that, when the commercial carbonate is first heated, long fibrous crystals form, but only in small quantity, on the walls of the retort-neck, before the real distillation commences. (Crystals, apparently the same, form on the sides of bottles soon after freshly-made commercial carbonate is stored in them.) These must be the salt which Dalton found (and probably correctly) to be the normal carbonate, as the first product of the real distillation of the commercial salt is, according to the analyses of both H. Rose and the author, not a true carbonate at all.

Ammonium carbonate occurs in the form of elongated plates or flattened prisms. It is intensely ammoniacal in smell and taste. Its composition is expressed by the formula  $\text{CO}_2(\text{OH}_2)_2(\text{NH}_3)_2$ . Dalton represented it as containing only half this proportion of water, but a comparison of his percentage numbers for it with those he gave for the acid carbonate shows that the salt in his hands really had the composition expressed by the above formula.

Exposed to the air, the crystals are very rapidly destroyed—ammonia escaping, and a wet mass of acid carbonate remaining behind. This change may be expressed as follows:—



At about  $58^\circ \text{C}$ ., it is converted into water, carbonic anhydride, and ammonia. It is soluble in its own weight of water, or slightly more, at  $15^\circ$ . When boiled, the solution gradually loses the salt, but does not otherwise change in composition. A warm saturated solution exhibits the phenomenon of supersaturation and sudden crystallisation in a well-marked manner, when it is allowed to cool in a closed vessel. The normal carbonate is insoluble in, and is decomposed by, alcohol; it is only very sparingly soluble at low temperatures in solution of ammonia. At a heat of  $20^\circ$ — $25^\circ$ , it is dissolved, with decomposition, in considerable quantity, in strong solution of ammonia, ammonium carbamate being formed. As a means of obtaining crystals of the carbamate, this interesting process for dehydrating the carbonate in solution will be again referred to.

2. *The Half-Acid Ammonium Carbonate.*—Rose obtained this salt by distilling the commercial carbonate very slowly until the contents of the retort liquefied, and leaving the liquid thus obtained to crystallise. H. Sainte-Claire Deville prepared it by crystallising a solution of the commercial carbonate in ammonia-water. It can also be obtained by the action of water on the commercial carbonate—by proceeding as in preparing the normal carbonate—the crops of crystals at length obtained on cooling the warm solutions consisting of the half-acid carbonate. Another method of getting it is to distil the ammonio-magnesian carbonate, the products being a fluid distillate depositing crystals of the half-acid carbonate, and a solid directly condensed, consisting principally, also, of this carbonate. It can also be formed by the action of alcohol on a solution of normal carbonate. It cannot be obtained, although the contrary has been asserted, by cooling a solution of the commercial carbonate to about  $0^\circ$ .

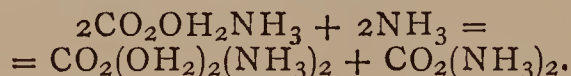
The half-acid carbonate occurs in the form of either thin, elongated, six-sided plates, or flattened right rectangular prisms, terminated by the faces of a rhombic octahedron. The properties of this carbonate appear to be all intermediate to those of the normal and the acid carbonates. The half-acid carbonate has a composition expressed by the formula  $(\text{CO}_2)_3(\text{OH}_2)_4(\text{NH}_3)_4$ . Rose found it to have another atom of water; but, as he has represented in the same paper some other salts as containing more water than they have been found by other chemists to contain, his results in this case may fairly be questioned. Deville deduced the same composition for this salt from his analyses as that given by Rose, because this was indicated by their mean results. But every sample analysed by him contained adhering water, and one very much more than another; so that it was obviously not right to take the mean results of the analyses as the nearest approach to the true composition of the salt. His analyses indicate, unequivocally, that he examined a half-acid carbonate with much less than five atoms of water—most probably, therefore, with only four atoms of (combined) water, as represented by the above formula.

The half-acid carbonate is soluble in a little more than five times its weight of water at  $15^\circ$ ; it is decomposed by less water. The mother-liquor of crystals of the half-acid carbonate is always either neutral, or slightly alkaline, in composition—that is, contains at least two atoms of ammonia to one of carbonic acid.

\* Abstract, by the Author, of a paper communicated to the Chemical Society.

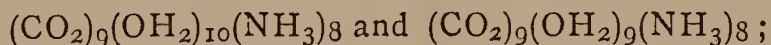


3. *The Acid Ammonium Carbonate*.—Unless Rose obtained, as he believed he did, crystals of this salt isomorphous with those of the acid potassium carbonate, it crystallises in only one form, though this may vary very much in the development of its proportions. Rose found the acid carbonate to vary in its degree of hydration, but his results are not in accordance with those obtained by other chemists. At about 60°, it is slowly decomposed into carbonic anhydride, ammonia, and water; on distilling it very slowly, the products of the distillation condense to nearly pure crystalline acid carbonate again. The acid carbonate dissolves in about 8 parts of water at 15°. When some of it is added to a cold saturated solution of itself, it is slowly decomposed, with evolution of bubbles of carbonic anhydride. A warm saturated solution, prepared in a closed vessel under pressure, deposits opaque crystals of it on cooling. A solution of it is converted into a much weaker solution of normal carbonate by boiling it for a time in a flask or retort. The acid carbonate is unaffected by alcohol. Dropped in powder into strong solution of ammonia, it is converted, with the production of a hissing sound and some heat, into a much greater bulk of normal carbonate, which deposits, and a salt which dissolves in the ammonia-water and crystallises out in small quantity on the walls of the vessel, when this is cooled to 0°, soon after the mixture is effected. This salt is probably ammonium carbamate, formed thus—



By digesting the acid carbonate with the strongest solution of ammonia, in a closed vessel at a temperature of 20°–25°, ammonium carbamate is slowly formed in considerable quantity.

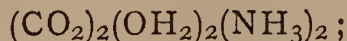
*The Hyper-Acid Ammonium Carbonate*.—Rose obtained this, crystallised from solution, on more than one occasion. He proposed for it the two complex formulæ—



but, as it soon passes into the acid carbonate spontaneously, and is, besides, formed under circumstances which generally bring about the formation of the acid carbonate, it may, with more probability, be regarded as mixed, when obtained with acid carbonate, and represented as having, when pure, the formula—



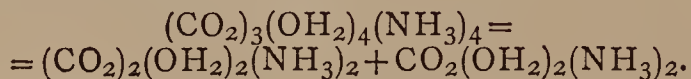
*Constitution of the Carbonates of Ammonium*.—The most characteristic reaction of the acid carbonate can only be represented as occurring in the quantity expressed by the formula—



viz., the reaction by which, when warmed with a little water, it passes into carbonic anhydride and the normal carbonate, thus—

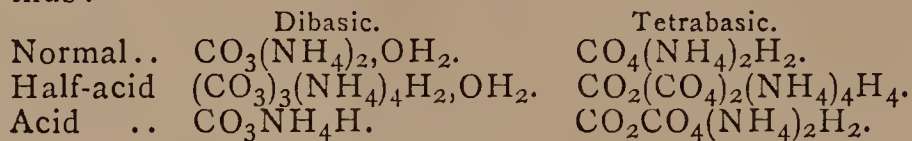


The acid carbonate being thus represented, the half-acid one may be regarded as a simple combination of it with the normal carbonate, thus—

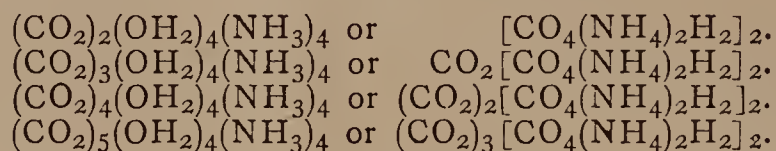


The probably tetrabasic character of carbonic acid in many of its salts is recognised by many chemists. The greatest objection to admitting this tetrabasic character seems to be that it shows apparently a dibasic character in a great number of its salts. This difficulty would be removed were the apparently dibasic salts represented as tetrabasic; and facts in the history of many of these carbonates appear to give support to the supposition that in them carbonic acid is actually tetrabasic. This is particularly the case with the carbonates of ammonium. That which is the normal carbonate of dibasic carbonic acid, with an atom of water of crystallisation, becomes a half-saturated salt of the tetrabasic acid; and that which is the acid salt of the dibasic acid becomes an anhydro salt of

the tetrabasic acid, in accordance with its chemical behaviour; while, lastly, the half-acid carbonate of the dibasic acid, with its one atom of water of crystallisation, so oddly associated with the treble molecule of carbonate, becomes a double salt of the other two tetra- or ortho-carbonates, thus:—

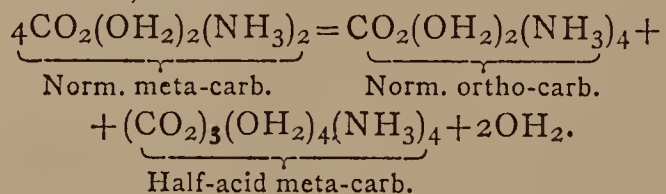


Admitting, with Rose, the existence of a hyper-acid carbonate, and adopting for it the formula proposed in this paper, the series of carbonates of ammonium which crystallise from their solutions stands thus:—



The regularity of this series is remarkable, and favours the theory that the half-acid, acid, and hyper-acid carbonates are anhydro compounds of the normal carbonate.

*The Normal Ortho-Carbonate of Ammonium*.—If the normal meta-carbonate is considered to be an acid ortho-carbonate, a normal ortho-carbonate—that is, a salt having the formula  $\text{CO}_4(\text{NH}_4)_4$ —may be supposed to exist. Aqueous spirit converts the commercial carbonate, both solid and in solution, into acid carbonate and a solution more alkaline in composition than the normal meta-carbonate. It acts similarly on a solution of normal meta-carbonate. When water is treated repeatedly with quantities of the commercial carbonate until crops of the half-acid carbonate are obtained, the mother-liquors prove to be more alkaline than the normal carbonate. Dalton mentions having obtained a solution of a “sub-tricar-bonate,” that is, of a salt having three atoms of ammonia to one of carbonic anhydride. Now it seems much less probable that, in these cases, the normal meta-carbonate resolves itself into the acid, or half-acid carbonate, and caustic ammonia, than into one of these salts and the normal ortho-carbonate (or, perhaps, the tri-ammonium ortho-carbonate), thus:—



Besides this, unless the mother-liquor from a crop of half-acid meta-carbonate crystals, which is equivalent to, or even more alkaline than, a solution of normal meta-carbonate, be regarded as containing both half-acid meta-carbonate and normal ortho-carbonate, the half-acid salt must be admitted to be quite insoluble in its own mother-liquor.

#### Ammonium Carbamate.

Besides mixing the dry gases, distilling ammonium sulphamate with anhydrous sodium carbonate (Rose), and passing dry ammonia and carbonic anhydride into absolute alcohol (Kolbe and Basaroff), there are several other ways by which the carbamate can be prepared. By passing carbonic anhydride and ammonia into concentrated aqueous solution of ammonia, the carbamate can be plentifully formed in crystals. By digesting, in a closed vessel, an aqueous solution of ammonia, saturated with the gas at a low temperature, with either the commercial carbonate or any other carbonate of ammonium, at a temperature of 20°–25°, for thirty-six or forty hours, the carbamate is formed, and either crystallises out at once on cooling, or will do so after cooling the solution in ice, charging it afresh with ammonia, adding more carbonate, repeating the digestion as before, and then again cooling. The commercial carbonate yields the most carbamate, as might be expected.

By heating the commercial carbonate with anhydrous potassium carbonate in a retort, the carbamate condenses



in the neck of the retort as a translucent, crystalline incrustation. The same result is arrived at when, instead of potassium carbonate, anhydrous calcium chloride is used. By distilling, extremely slowly, the commercial carbonate by itself, the parts of the product formed farthest from the heat consist almost entirely of carbamate. The product of distilling the normal carbonate by a heat of  $60^{\circ}$  is nearly pure carbamate. The distillation of the commercial carbonate with strong aqueous spirit also yields an impure carbamate.

Ammonium carbamate occurs in the form of flocculi; of an incrustation more or less crystalline; of prisms found sometimes projecting from this incrustation; of crystalline laminae (Kolbe and Basaroff); and of well-marked, handsome crystals, neither tabular nor decidedly columnar. Exposed to the air, the carbamate evolves an odour of ammonia, deliquesces, and gradually volatilises almost entirely, the residue being acid carbonate. Although it has a strong physical attraction for water, it only slowly combines chemically with it, especially in the presence of ammonia. Thus, though it deliquesces, very little carbonate must be formed, because so little acid carbonate remains as a residue. Again, it can be obtained in crystals by the union of ammonia and carbonic anhydride in water; it can be dissolved in ammonia-water, and crystallised out again; it can be formed by the dehydration of the carbonate in the presence of water; and it can be a product of distillation along with water. It dissolves, with the sensible production of cold, in about  $1\frac{1}{2}$  parts of water; it dissolves unchanged, but soon passes into carbonate; it dissolves in a little more than 2 parts of strong solution of ammonia at  $15^{\circ}$ . From this solution, it can at first be crystallised out by cold, but after awhile the carbonate crystallises out at ordinary temperatures.

(To be continued.)

## DESCRIPTION OF DR. C. SCHIEBLER'S CALCIMETER,

OR APPARATUS FOR THE QUANTITATIVE ESTIMATION OF  
THE CARBONATE OF LIME IN BONE-BLACK BY  
VOLUMETRICAL ASSAY.

THIS apparatus is adapted for the estimation of the quantity of carbonic acid contained in native carbonates, as well as in artificial products, and has been specially contrived for the purpose of readily estimating the quantity of carbonic acid contained in bone-black. The principle upon which the apparatus is founded is simply this:—That the quantity of carbonic acid contained in carbonate of lime can, according to well-known stoichiometrical rules, be used as a measure of the quantity of that salt itself; and instead of determining, as has been usually the case, the quantity of carbonic acid by weight, this apparatus admits of its estimation by volume, and it is by this means possible to perform, in a few minutes, operations which would otherwise take hours to accomplish, while, moreover, the operator need scarcely possess any knowledge of chemistry. The analytical results obtained by means of this apparatus are very correct, provided care be taken to use all the needful precautions.

The apparatus is shown in the annexed woodcut, and consists of the following parts:—(1). The glass vessel, A, serves for the decomposition of the material to be tested for carbonic acid, which, for that purpose, is treated with dilute hydrochloric acid; this acid is contained, previous to the beginning of the experiment, in the gutta-percha vessel, s. The glass stopper of A is perforated, and through it firmly passes a glass tube, to which is fastened the india-rubber tube, r, by means of which communication is opened with B, a three-necked tubulated bottle. The central neck of this bottle contains a glass tube, v, firmly fixed, which is in communication, on the one hand, with

A, by means of the flexible india-rubber tube already alluded to, and, on the other hand, *inside* of B, with a very thin india-rubber bladder (similar, as regards thinness, to the very light and well-known inflated india-rubber balloons sold as toys). The neck, q, of the vessel B is shut off during the experiment by means of a piece of india-rubber tubing, kept firmly closed with a spring clamp; the only use of this neck of the bottle, B, arranged as described, is to give access of atmospheric air to the interior of the bottle, if required. The other opening is in communication with the measuring apparatus, c, a very accurate cylindrical glass tube, of 150 c.c. capacity, divided into 0.5 c.c.; the lower portion of this tube c is in communication with the tube d, serving the purpose of controlling the pressure of the gas; the lower part of this tube d ends in a glass tube of smaller diameter, to which is fastened the india-rubber tube, p, leading to E, but the communication between these parts of the apparatus is closed, as seen at p, by means of a spring clamp. E is a water reservoir, and on removal of the clamp at p, the water contained in c and d runs off towards E; when it is desired to force the water contained in E into c and d, this can be readily done by blowing with the mouth into v, and opening the clamp at p.

The following apparatus are also supplied with the instrument:—A small and very accurately made weight for weighing off the substances to be tested; a thermometer; a bottle with hydrochloric acid; a bottle containing a solution of carbonate of ammonia; several small porcelain basins; and a book of description, with tables for facilitating the calculations.

The main portion of the apparatus above described, with the exception, however, of the vessel A, is properly fixed by means of brass fittings to a wooden board, as represented in the woodcut. The filling of the apparatus with water is very readily effected by pouring it through a suitable funnel placed in the open end of the tube d, care being taken to remove, or at least to unfasten, the spring clamp at p; in this manner the water runs into E, which should be almost entirely filled. Distilled water is preferable for this purpose, especially as the filling only requires to be done once, because the water always remains in E as long as the apparatus is intended to be kept ready for use. When it is required to fill the tubes c and d with water, so as to reach the zero of the scale of the instrument, it is best to remove the glass stopper from A. The spring clamp at p is next unfastened, and air is then blown by means of the mouth into the tube v, which communicates with E; by this operation the water rises up into the tubes c and d, which thus become filled with that liquid to the same height. Care should be taken not to force the water up above the zero of the scale at c, and especial care should be taken against forcing so much of the fluid up that it would run over into the tube u, and thence find its way to B, whereby a total disconnection of all the parts of the apparatus would become necessary. If by any accident the water should have been forced up above the zero at c, before the operator had closed the spring clamp at p, this is easily remedied by gently opening that clamp, whereby room is given for the water to run off to E in such quantity as may be required to adjust the level of that fluid in c precisely with the zero of the scale. The filling of the tube c with water has the effect of forcing the air previously contained in that tube into B, where it causes the compression of the very thin india-rubber ball placed within B; if it should happen that this india-rubber ball has not become sufficiently compressed and flattened, it is necessary to unfasten the spring clamp at q, and to cautiously blow air into B, through the tube, q, by which operation the complete exhaustion of the india-rubber bladder placed within B is readily performed. This operation is also required only once, because during the subsequent experiments the india-rubber bladder, k, is emptied spontaneously. It may happen, however, that while the filling of the tubes d and c with water is being proceeded with, the india-rubber bladder, k, has become



fully exhausted of air before the water in c reaches the zero of the scale; in that case the level of the water in the tubes D and c will not be the same, but will be higher in D; it is evident, however, that this slight defect can be at once remedied by momentarily unfastening the spring clamp at q.

The apparatus should be placed so as to be out of reach of direct sunlight, and should also be protected against artificial heat, and all sources of heat which might give rise to sudden changes of temperature; the instrument is best placed near a north window, so as to afford sufficient light for reading off the height of the water in the tubes.

The following reagents are required for use with this apparatus:—

*Hydrochloric Acid.*—The acid required for the decomposition of the bone-black is poured into the vessel

poured over the salt the mixture of water and ammonia, and the solution of the salt promoted by frequent shaking of the bottle. The solution of carbonate of ammonia is used for the purpose of converting into carbonate of lime any caustic lime which might be present in the materials to be submitted to analysis.

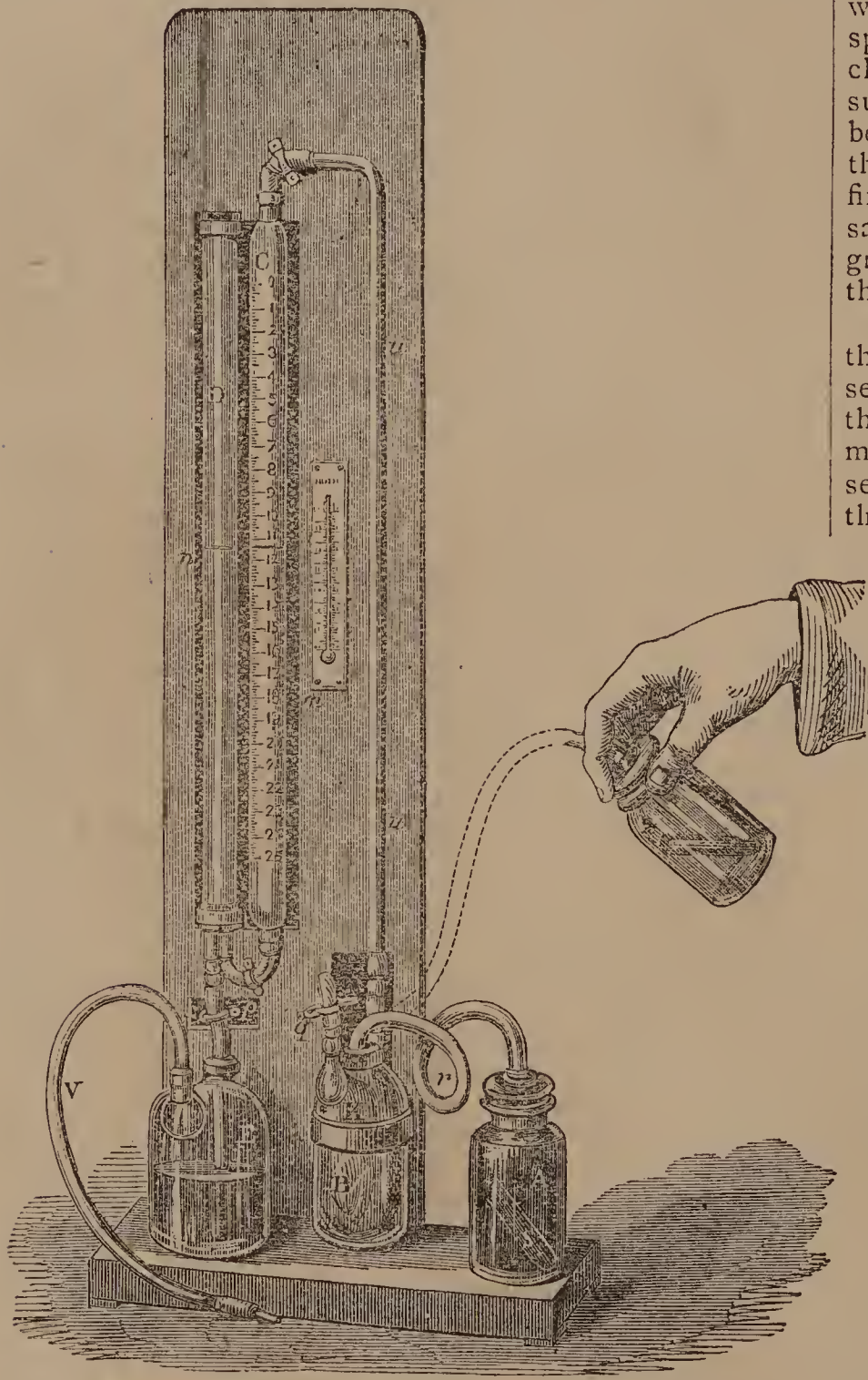
*Method of Testing Bone-Black for the Quantity of Carbonic Acid it Contains.*

*Preliminary Operations.*—It is of the greatest importance that a good average sample, really representing the entire bulk of charcoal, be taken for investigation; this can be readily obtained by taking, say, from the filter (in sugar works) or from a cask, small samples, say a few ounces, at various depths of the vessels containing the material; or, better still, if there be room, the charcoal should be placed in a heap on a large sheet of stout canvass, and well mixed together, and samples taken from various spots of the heap. These, if wet (as will be the case with charcoal just removed from the filters), should be dried by suitable means, and afterwards the whole sample should be coarsely ground and thoroughly mixed, and a portion thereof taken for the purpose of being ground up to a very finely divided powder, to serve the purpose of weighing a sample from. It is essential that the charcoal should be ground to a very fine powder, because it greatly promotes the decomposition in the apparatus by the acid.

*Weighing off of the Sample for Analysis.*—We have seen that there is added to the apparatus a metallic weight to serve as normal weight. This weight is placed in one of the pans of balance (when no balance is at hand purposely made for chemical weighing, any balance, provided it be sensitive to from 1-8th to 1-10th of a grain, will answer the purpose); in the other pan a small porcelain basin is placed, and equilibrium is restored by means of small lead shot. As soon as the equilibrium is restored, the normal, or standard, weight is removed from the pan of the balance, and there is placed in the small porcelain capsule and added to the pan as much of the sample of bone-black to be tested as is required to restore the equilibrium. When several experiments have to be made consecutively, it is better to arrange beforehand the joint tare weight of the normal weight, and of a watch glass of suitable size, and to weigh off upon the latter the several samples. The author recommends the transference of these weighed quantities to a porcelain capsule, because, according to his plan, the samples, *after* having been weighed, have to be thoroughly moistened with the solution of carbonate of ammonia already referred to, in order to convert any caustic lime which might happen to be present in the material into carbonate of lime; but we think it is a decided improvement to moisten gently with the aforesaid solution of carbonate of ammonia a sufficient quantity of the samples to be tested previous to weighing them; to dry these, as also directed by Dr. Schiebler, and to apply at last, for a few moments, a stronger heat short of red heat (say an air or fusible metal bath, heated to 240° C.), so as to obviate the chance of either an excess of carbonate of ammonia or of water being present, while, at the same time, the decomposition of the carbonate of lime is guarded against.

After the samples are quite cold, they are to be transferred to the flask or bottle A. The author states that more recent researches have proved that bone-black which has been once used for filtering purposes in sugar works no longer contains any caustic lime, and the treatment with carbonate of ammonia can therefore be dispensed with in that case, and need only be employed with samples freshly made.

The experiment for the quantitative estimation of the carbonic acid is carried out in the following manner:—First the water in the tube c is made to stand exactly at the zero (o) of the scale; next the weighed sample of the bone-black to be tested is transferred with great care and without loss, to the bottom of the bottle, A, which should be perfectly dry inside and quite clean. This having been



for use during experiments. This acid need not be pure; the crude acid of commerce answers the purpose, provided it be so diluted that its specific gravity at 17° C. is 1.120. It is not even necessary to adhere rigorously to this strength, and for all purposes here required, it is sufficient to mix two parts by bulk of water with one part by bulk of the commercial hydrochloric acid.

*Carbonate of Ammonia.*—In order to prepare the solution of this salt of the necessary strength, one part by weight of the ordinary carbonate of ammonia of the shops is dissolved in four parts of water, to which one part of liquid ammonia has been added. The salt is first coarsely pulverised, and immediately after placed in a bottle provided with a well ground-in glass stopper; there is next



done, the gutta-percha vessel, *s*, which should also be previously well cleaned, is filled with the hydrochloric acid above referred to, to within from  $\frac{1}{2}$  to  $\frac{3}{4}$  inch from the top, care being taken not to drop any hydrochloric acid on the outside of that vessel; this gutta-percha vessel is next placed within the bottle *A* in a slanting direction, as shown in the woodcut; after this the glass stopper is replaced on *A*, care being taken to slightly grease it and the inside of the neck of *A*, thereby securing a better air-tight fitting. The closing of *A* will (if all parts of the apparatus are properly tight) have the effect of slightly lowering the level of the water in *c*, below the zero of the scale, while the water will rise just as much higher in *d*; by unfastening, for a moment, the spring clamp at *q*, the normal height is properly restored. The operator should very carefully guard against handling or touching *A* after it has been once closed, because, by so doing, the warmth of his hand will cause the expansion of the air in *A*, and thereby affect the proper action of the apparatus. In order to cause the hydrochloric acid contained in the gutta-percha vessel placed inside *A* to run on to the animal charcoal, placed on the bottom of *A*, as described, the flask or bottle *A* is taken hold of by the neck, as delineated in the woodcut. As soon as the acid comes into contact with the bone-black, the evolution of carbonic acid gas begins, and with it also the expansion of the very thin india-rubber bladder, *k*, while the water in the tube *c* sinks, and correspondingly rises in *d*. While the bottle *A* is held in the right hand, as already indicated, and gently moved about so as to promote, as much as possible, the contact between the acid and the charcoal, the left hand is employed to gently open the spring clamp, *p*, in such a manner as to run off towards *e* just as much water as is required to keep the level in the tubes *c* and *d* at the same height; both these manipulations should be continued as long as any sinking of the level of the water in *c* is perceptible; in other words, as long as any carbonic acid is given off. After this has quite ceased, and no change is perceptible, or any motion of the water in the tubes, just alluded to, has taken place, the operation may be considered at an end, care being taken, however, to keep the levels in the tubes *c* and *d* at precisely the same height. This having been done, the next step is to read off the height of the water at the scale on *c*, and simultaneously the thermometer.

## EXPERIMENTS ON BUNSEN'S FILTER PUMP.\*

By ROBERT H. RICHARDS, M.E.

IN the summer of 1869 I was asked by Professor Storer to put up Bunsen's filter pump for the laboratory of the school. In complying with his wishes I have been led to try a number of experiments upon the most efficient form of pump, and have arrived at some conclusions which seem to be worth recording.

It is evident, *à priori*, that an even flow of air and water is necessary, in order to obtain the best results, otherwise the tension of the air inside the partially exhausted vessel will not be constant. The bubbles of air should be round rather than elongated, should be uniformly distributed throughout the entire length of the column of water, and of no smaller diameter than the pipe itself, for if the bubbles are of less diameter than the pipe they will continually flow upwards through the water, and thus a portion of the useful effect of the water would be lost; and if the bubbles are much longer than the diameter of the tube, the vertical column of falling water may be much diminished in length.

In each of the figures (Figs. 1, 2, 3, 4, 5), *a* represents the air-tube, or the tube through which the air is drawn

into the pump; and *f* represents the tube through which the water is fed to the pump.

In the pump described by Bunsen, Fig. 1 (CHEMICAL NEWS, vol. xix., p. 160), I find no small difficulty in adjusting the end of the tube, *p*, so that the above conditions may be fulfilled. I have worked with four different pumps of this pattern, but have never obtained a completely satisfactory result for all rates of speed of flow. At times, when the rate of flow was small, a bubble or air space as much as a foot long would collect just below the pump.

After experimenting for some time with the form Fig. 1, I tried the form Fig. 2, in which the water flows through a tube of uniform bore throughout its entire length, and the air is drawn in through a small aperture in the side of the tube. By this arrangement the result sought for is attained very fairly, the tube being filled with the desired even mixture of bubbles of air and water. Fig. 3 represents a simpler form of the same apparatus, which affords equally good results, and which now receives preference to other forms in the laboratory of the Institute of Technology.

Some time after I had devised this form of pump, I observed that Sprengel (CHEMICAL NEWS, vol. xvii., p. 85) had previously described a similar tube to be used as an aspirator. It should be observed that Sprengel's aspirator is worked by pressure of a column of water, which has not yet entered the apparatus, while in Bunsen's arrangement the power is derived solely from the column of water which has passed the point at which the air and water mix.

The idea subsequently occurred to me that the bubbles might be delivered more evenly and of uniform size if the air were made to bubble up through water contained in a little reservoir, as in *e*, Fig. 4. I find, in fact, that in passing through the water in the reservoir, *e*, the air naturally breaks up into bubbles of uniform size and shape. The same result may be accomplished just as well by the somewhat simpler arrangement, Fig. 5, in which the enlargement, *e*, is dispensed with, but the position is maintained.

The mode of working of this apparatus is probably as follows:—The feed water tends to flow up the air-tube, *k* (Fig. 5), but is met by the air which is being drawn in by the column of water in the waste-tube and is thus forced back for a moment so that a bubble of air is delivered into *i*; the water then rushes up again towards *k*, and is again forced to retreat so as to allow another bubble of air to pass. A continual oscillation between air and water evidently occurs at this point.

I have made several pumps of the form represented in Fig. 5, of tube varying in size from  $\frac{1}{8}$ -inch bore to  $\frac{1}{2}$ -inch, taking care that the air-feed and waste-tubes in each one of the several pumps should be, as nearly as possible, of the same, and I find that even the pump of  $\frac{1}{2}$ -inch bore will yield bubbles of equal size and equally distributed when the supply of air is checked as would be the case when used to exhaust air from a vessel, or when the air is fed into the pump through a small orifice. In this form of apparatus, Fig. 5, the water has no tendency to flow down the walls of the tube, so as to leave elongated air spaces in the centre.

The great advantage of Figs. 3 and 5, is the ease with which they may be made, a single T-joint forms the whole essential part of the construction, but in Fig. 1 the end of the tube at *p* must be carefully adjusted, otherwise the water cannot be allowed to flow at a very slow rate. Fig. 3 will answer well for pumps  $\frac{1}{4}$ -inch in bore or less, but the form Fig. 5 should be used for any pump larger than  $\frac{1}{4}$ -inch. Fig. 5 represents the only form of pump which, when of a bore much exceeding  $\frac{1}{4}$ -inch, seems to be capable of taking down air in the form of bubbles; hence it is the form to be used, if this principle is ever applied on a manufacturing scale in chemical works, in procuring a vacuum for pumping mines, &c.

\*Communicated by the Author.



The following experiments were performed rather with a view to explore the subject than with any definite purpose. My apparatus was faulty, the tubes were of the best glass tubing I could find; but glass tubes are, more or less, conical. The connections were all made of caoutchouc tubing made air-tight with shellac. With the large pump, I think the error in starting and stopping the experiment does not exceed 100 c.c. of water; with the small one the error could not amount to 10 c.c.

In the experiments with the  $\frac{1}{2}$ -inch bore pump, up to 15 litres of water were used in an experiment; in experimenting with the  $\frac{1}{4}$ -inch pump, up to two litres; with the  $\frac{1}{8}$ -inch pump, up to 1200 c.c. In the tables here given the water is used as the standard of comparison, and the other elements are reduced in the right proportion.

The first column in the tables, marked height of water column, represents the measurement of the whole fall of water. The second column represents the height of mercury corresponding to that amount of water. The third column, marked P, shows the height of mercury in the manometer, which, in any experiment, if the air be stopped, the water is capable of counterpoising, when it is flowing through the pump at the rate shown by the corresponding water and time columns. The fourth and fifth columns show respectively the amount of water and air which were collected at the foot of the waste-tube, in the time represented in the sixth column.

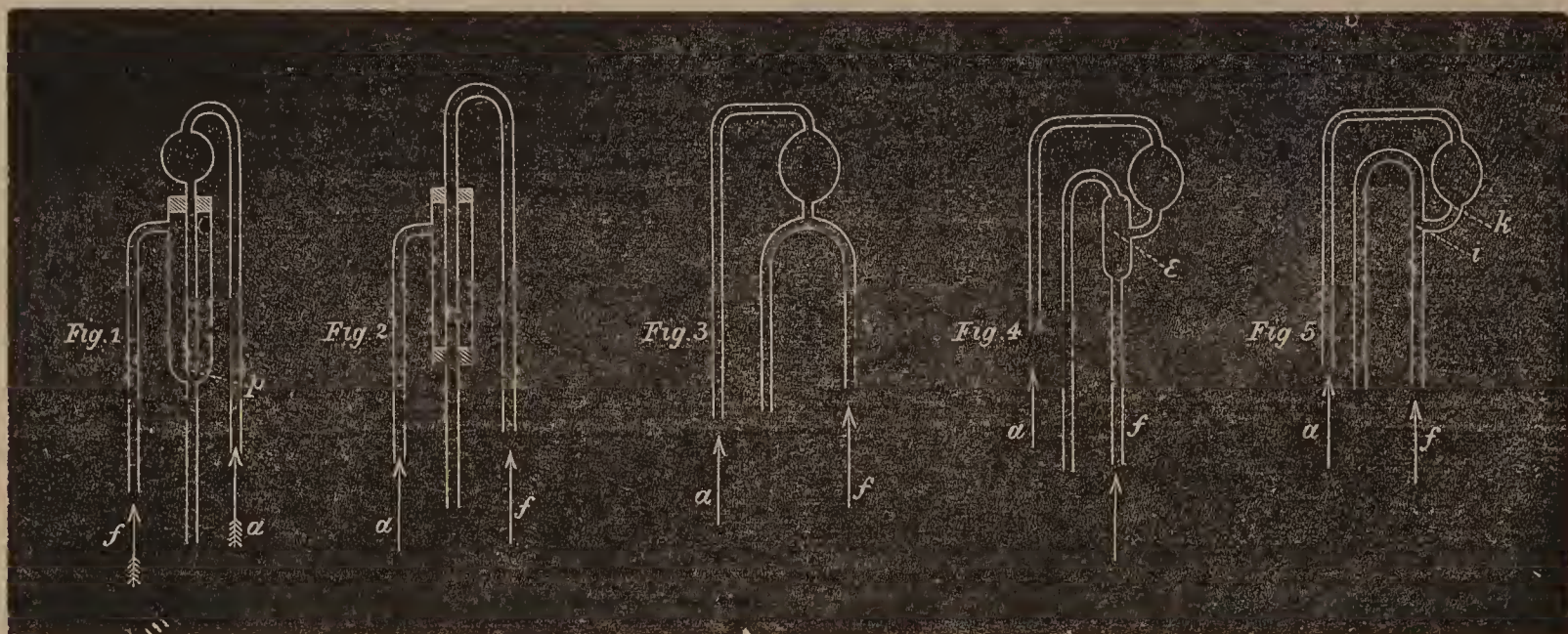
Experiment 29 was tried four times, but failed on account of the very small power of the water to carry down air when flowing at that rapid rate.

#### Results of Experiments performed with $\frac{1}{4}$ inch Bore Pump

	Height of column of water.	Corre- sponding column of mercury.	P.	Water.	Air.	Time.
	m.	m.m.	m.m.	c.c.	c.c.	m. s.
13.	2'36	174	169'0	1000	3402	5 52
14.	"	"	164'0	"	1561	1 42
15.	"	"	160'0	"	1286	1 25
16.	"	"	151'0	"	861	1 1
17.	"	"	134'0	"	449	0 41
18.	"	"	112'0	"	181	0 29
19.	"	"	92'0	"	85	0 25
20.	"	"	70'0	"	14	0 21
21.	"	"	0	"	0	0 15

#### Results of Experiments performed with $\frac{1}{8}$ inch Bore Pump.

	Height of column of water.	Corre- sponding column of mercury.	P.	Water.	Air.	Time.
	m.	m.m.	m.m.	c.c.	c.c.	h. m. s.
22.	2'385	175	170	1000	48,142	12 41 0
23.	"	"	172	"	4,280	0 22 0
24.	"	"	155	"	1,610	0 8 28
25.	"	"	120	"	376	0 3 29
26.	"	"	92	"	138	0 2 38
27.	"	"	73	"	87	0 2 29
28.	"	"	51	"	31	0 2 15
29.	"	"	23	(Failed four times.)		
30.	"	"	0	"	0	0 1 59



#### Results of Experiments performed with the $\frac{1}{2}$ inch Pump, all Reduced to the Standard of 20 litres.

	Height of column of water.	Corre- sponding column of mercury.	P.	Water.	Air.	Time.
	m.	m.m.		c.c.	c.c.	m. s.
1.	3'05	224	219	20,000	36,374	10 26
2.	"	"	219	"	32,454	7 25
3.	"	"	217	"	29,501	5 45
4.	"	"	214	"	30,133	5 22
5.	"	"	208	"	31,251	5 29
6.	"	"	200	"	29,501	4 31
7.	"	"	189	"	16,287	2 40
8.	"	"	179	"	12,229	2 11
9.	"	"	157	"	8,522	1 51
10.	"	"	130	"	4,802	1 31
11.	"	"	84	"	1,187	1 9
12.	"	"	0	"	0	0 51

If a curve be drawn having the various times above for its abscissas, and the corresponding height of mercurial column from column P for its ordinates, there will be found an irregularity in the curve along by Experiments 4, 5, and 6; this I believe to be owing to defects in the tubing. There is nothing of the kind to be seen in either of the other sets of experiments.

We see, at once, by these experiments, that the longer the time taken to run a given amount of water, or, in other words, the slower the stream, the more air it is capable of carrying down, and the more it is capable of raising the mercurial column when the air is stopped.

The capacity of the pump might be discussed as follows:—

Let P = the number of pounds on the square inch due to H = the total fall of water.

Let r = the ratio of the volume of water in the tube at any time to the whole volume of the tube.

Let h = the useful fall of water.

Then  $h = Hr$ , and  $P = H \times \frac{14.7}{32}$  (for every vertical foot

of water represents  $\frac{14.7}{32}$  lbs. of pressure per square inch),

but P is never realised, for we never have H, height of water, but Hr; hence, without considering other losses,

the power =  $p = Hr \frac{14.7}{32}$  lbs. per square inch; and since

r appears in the numerator it is evident, that other things being equal, the more water and the less air the more will be the tension. Loss of power is also due to the retarding influence of friction, f, upon the falling stream, and also is due to the flow of the feed stream. Suppose



the air is allowed free passage, and, under these circumstances, if the velocity in the waste-pipe = 20 feet per second, and that in the feed-pipe = 18 feet per second, we should have a difference = 2 feet per second, which is all that is useful in pulling down air, and which 2 feet per second is due to a fall of only about an inch; by allowing the above rate of speed we should reduce our effective head to 1 inch =  $h$ .

Let  $v$  = useful velocity.

Let  $v_1$  = velocity of waste.

Let  $v_2$  = velocity of feed.

Then  $v = v_1 - v_2$ ,

or the smaller  $v_2$  is and the larger  $v_1$  the greater will  $v$  be; hence, the greatest exhaustion is obtained by turning the feed water off entirely, provided the waste-pipe is full, and, as a rule, the slower the rate of flow the more power due to this cause.

To collect our data we have:—

No. 1. The more water and less air in the waste-tube the more tension.

No. 2. Friction increases with velocity of flow; hence, the slower the stream the more the power.

No. 3. The slower the rate of speed of feed-water the more power. (This follows from 2).

No. 1 may be seen practically in a moment at the pump; thus the water is turned on, and as soon as the waste-pipe is filled with bubbles of air and water the air opening is stopped, the manometer at once begins to rise, and continues to do so until no more bubbles are seen in the waste-tube, when the manometer will stand still and give the maximum exhaustion due to the head, with the rate of speed used.

No. 2 can also be seen in a moment, for the feed can be turned on fast enough to stop all air from coming in when the air has free admission, and, in fact, to force the water back up the air-tube, which would not be true to the laws of falling bodies if it were not for friction.

No. 3 is exemplified thus:—In experiment under No. 1, when the waste-pipe has no air bubbles in it, and is being steadily fed with water, the speed of the feed-water is suddenly increased; the manometer will go down a little if, on the other hand, the feed is partially cut off or its speed checked; a few air bubbles will go down the waste-tube and the manometer will rise; the manometer will be found at its maximum when the waste-pipe is full of water and the feed is entirely cut off.

Next, it is evident that these results conflict with each other, or that there is some point at which a maximum effect can be obtained, though not quite maximum tension nor volume of air per volume of water.

For instance, look back to Experiment 15. We find 1000 c.c. of water carried down 1286 c.c. of air in 1 min. 25 secs. Also look at Experiment 13, 1000 c.c. of water carried down 3402 c.c. of air, but took 5 min. 52 secs. to do it. I think we should find the rate of speed used in Experiment 15 very much more advantageous than that in 13, for the former would carry down very much more air per minute and with very slightly decreased power, as shown by column P.

I have not yet had time to try similar experiments with the form Fig. 1. Very probably the difference between two pumps, one of which delivers its air evenly while the other does not do so, may be small and in fact may, perhaps, be hard to discern in the practical use in the laboratory; still we should use the tools which theoretically work the best, provided no fault can be found with them in practice.

When the platinum cone was tried as represented (CHEMICAL NEWS, vol. xix., p. 160), it was found to clog with a very small amount of precipitate; the same cone was punched with a large number of holes  $\frac{1}{8}$  of an inch in bore or thereabouts, and the liquor ran through much faster. It was then observed that the precipitate always collected upon that portion of the filter which was in immediate contact with the platinum cone much more than

anywhere else, and, therefore, that the liquor ran through the paper mostly where it was in contact with the platinum, and hence, it seemed probable that the larger the cone the more quickly would the filtration be performed. A cone was then made  $1\frac{1}{2}$  inch in slant height, and punched with the same sized holes, and the water was found to run through very much faster than before. I find that this cone for quickness and for safety is much better than any I have tried; it can be put into any common funnel, no matter how imperfect.

I found that when the filter pump was not used, that I could filter much faster with the large cone under my filter than without it, which exactly corroborates Avery's experiments (*American Journal of Pharmacy*, May, 1868, and also the observation of R. Dale, in the CHEMICAL NEWS, vol. xx., p. 128).

Mass. Institute of Technology,  
Boston, June, 1870.

## ON THE ANILINE OR COAL-TAR COLOURS.\*

By W. H. PERKIN, F.R.S.

(Continued from p. 66).

### *Various Aniline, Phenol, and Naphthalin Colours—Application of the Coal-Tar Colours to the Arts.*

LAST lecture we considered, among other subjects, magenta and some of its coloured derivatives, as the blues and violets. This evening we commence with some of the green colouring matters which have also been produced from magenta. The first green colouring matter we shall consider is the "aldehyd green," which owes its name to a substance called "aldehyd" being employed in its preparation. I must, therefore, first tell you what aldehyd is.

Aldehyd is a product of the oxidation of alcohol; it is a volatile liquid possessing a very peculiar odour, and was discovered by a chemist named Döbereiner, but analysed by Liebig. It is obtained by treating alcohol with a mixture of bichromate of potassium and sulphuric acid, and was generally prepared in glass retorts, but, now that it is required for colour making, the glass apparatus is replaced by copper or leaden vessels.

Towards the end of 1861, M. Lauth described a reaction by which rosaniline could be made to produce a blue colouring matter; but this product was found to be useless as a dye, on account of its instability. It was produced by the action of aldehyd upon a solution of rosaniline and sulphuric acid. This useless colour was afterwards experimented upon by a dyer named Chirpin, who, after a number of fruitless attempts at fixing it, told his difficulties to a photographic friend, who evidently thought if it was possible to fix a photograph it was possible to fix anything else. He, therefore, advised his confidant to try hyposulphite of sodium. On making this experiment, however, the dyer did not succeed in fixing his blue, but found it converted into a splendid green dye, now known as aldehyd green.

To prepare this colouring matter, a cold solution of magenta, consisting of one part of colouring matter dissolved in a mixture of three parts of sulphuric acid, and one part of water, is employed; about one and a half parts of aldehyd are added by degrees to this solution, and when the whole is mixed it is heated on a water bath, until a drop of the product diffused in water produces a fine blue colouration. It is then poured into a large quantity of boiling water, containing three or four times as much hyposulphite of sodium as the magenta employed. After boiling a short time the product is filtered off from a greyish insoluble residue which forms. The filtrate contains the green. This process being a very simple one, a

\* The Cantor lectures, delivered before the Society of Arts.



great number of dyers now prepare the colouring matter as they require it. It may, however, be precipitated by means of tannin or acetate of sodium, collected on filters and drained to a paste, and, if necessary, dried. In both these forms it is found in the market.

The aldehyd green is principally employed in silk dyeing. It is a splendid colour, and very brilliant both by day and artificial light. The chemistry of this green is at present hidden in obscurity, as it is very difficult to obtain in a chemically pure condition. But like the colouring matter previously described, it is undoubtedly the salt of an organic base apparently containing sulphur.

This base is colourless, or nearly so, and becomes changed to the normal colour of aldehyd green upon absorption of carbonic acid.

It will also decompose ammonia salts, combining with the acid and becoming green. I have here a solution containing the colourless base of this green, an ammonia salt and a little free ammonia. If I pour it upon a piece of white blotting-paper it does not stain it, but if I heat it the ammonia salt is decomposed, and we get the green developed with its ordinary intensity.

There is another green of an entirely different nature to the aldehyd green; it is called the iodine green. This colouring matter is always produced, but in variable quantities, in the preparation of the Hofmann violets, from magenta and iodide of ethyl or methyl. Of late, much attention has been directed to this colouring matter, and by making a few alterations in the process for preparing the Hofmann, from forty to fifty per cent of product can now be obtained from the magenta used. The iodine green is much used for cotton and silk dyeing; its colour is bluer than that of aldehyd green, and it is, therefore, more useful, as it yields, with the addition of yellow, a greater variety of green shades.

Iodine green contains an organic base which is not precipitated by alkaline carbonates. With picric acid it forms a difficultly-soluble picrate, and is generally prepared on the Continent as a paste consisting of this colour precipitated with picric acid and drained on a filter. In England it is, however, sold in alcoholic solution. It is a good green by gaslight.

The next green I have to bring before you is a magenta derivative, commercially called "Perkin's green." In its properties it resembles more closely the iodine than the aldehyd green, but differs from this in its solubility, and in being precipitated by solutions of alkaline carbonates, as carbonate of sodium. It is an organic base which is nearly colourless, and is by no means a chemically powerful body. Like the iodine green, it is precipitated by picric acid, forming a picrate which crystallises from alcohol in small prisms with a golden reflection. This colouring matter is principally employed for calico printing, and is now extensively used. Thus you see we have three aniline greens, some useful for one, and some for another purpose, so that the silk and cotton dyer, and the calico-printer, as well as others can be supplied. For fastness these greens are, I think, quite as good as the violets; the aldehyd green, however, I believe, resists light the best.

In the formation of the mauve, or aniline purple, there is always a small quantity of a second colouring matter produced, of a rich crimson colour, similar to that of safflower. Several years ago I examined this substance, and found it to dye silk a remarkably clear colour, but owing to the press of other matters, and the very small quantities in which it could be obtained, I did not give it any further attention. By a new process, however, it can now be produced in somewhat larger quantities, and endeavours are being made to introduce it to the arts, as it produces beautiful tints of pink upon silk and cotton, and, moreover, can be used for printing cotton, silk, and wool processes, to which safflower cannot be applied as it will not bear steaming. This aniline pink or crimson is a beautiful chemical body, crystallising in small prisms, possessing a golden green lustre. It is soluble in alcohol,

and also in water; it produces solutions remarkable for their fluorescence, so much so, that by certain lights they appear as if filled with a precipitate. In colour and fastness it is equal to safflower, and should it be found possible to manufacture it at a moderate price, I should imagine it would entirely supersede that colouring matter, especially as it is not affected by alkaline solutions.

There is a product in the English market supposed to be an aniline colour called "Field's orange," after its discoverer, Mr. Frederick Field. Its properties are those of a nitro-acid, but as its preparation has not been described, of course I cannot tell you anything about it. With alkalies it forms a rich orange-coloured solution, but by the addition of an acid it is precipitated as a pale yellow powder.

Field's orange is a very useful colouring matter, having a great affinity for animal fibres, and is extensively used for wool-dyeing, as it resists the action of light very well.

We now come to a colouring matter of a very indefinite nature. I refer to aniline black. This substance appears to be closely allied to the insoluble part of the black precipitate formed in the manufacture of the mauve. This precipitate, however, always contains oxide of chromium, which cannot exist in the aniline black generally employed, as no chromium compound is used in its preparation, but as copper compounds are used, it may be that aniline black represents the black precipitate with the oxide of chromium replaced by the oxide of copper, or it may even be that in either case the metallic oxide is not an essential part of this black substance.

Aniline black is perfectly insoluble, and has, therefore, to be formed upon the fibre when employed for calico printing. As we shall have to refer to its application to dyeing and printing, I will not make any further remarks upon it just now.

From mauve and magenta, chocolate maroons and browns are prepared, but, as they are of secondary importance as yet, I will only just mention one or two of the methods of preparing them.

One of the processes for preparing chocolate from magenta is by the action of nitrous acid, but care has to be taken to watch the progress of the operation, and to stop it when the required shade has been obtained. Another process consists in heating magenta with hydrochlorate of aniline to a temperature a little above 200° C. The product, when purified, produces a maroon colour. Browns are generally obtained from the residue of magenta making.

All the colouring matters we have considered up to the present time are derivatives of aniline and toluidine, and constitute nearly all the colours of the rainbow.

By the action of nascent hydrogen upon dinitrobenzol, Mr. A. H. Church and myself obtained, in 1857, a crimson colouring matter, which was named nitrosophenylene. I have lately made a few new experiments upon this remarkable body, and find that it has an affinity for pure cotton, dyeing it of a clear cerise colour, considerably less blue in tint than safflower. With very dilute acids, this colouring matter forms a blue solution; with less dilute acid, a crimson colour, and with concentrated sulphuric acid a green colour. It is difficult to judge of the probable utility of this colouring matter, as it is so difficult to obtain in quantity by the present process. I may mention that my new experiments with this substance have caused me to doubt the purity of the product examined by Mr. Church and myself; and this is not remarkable when we consider how few methods of purifying artificial colouring matters were known at the date of our experiments, as well as the small amount of substance at our disposal.

We now turn to a product very different from aniline, though related to it in some respects very closely. On the table you will see a coal-tar product called "phenol," or "carbolic acid." It was discovered, a long time since, by Runge, and afterwards studied by a great number of chemists. It is only, however, during the last few years, that it has been introduced into commerce in a pure con-



dition, thanks to Dr. Crace Calvert, so well known to the Society of Arts.

Phenol or carbolic acid is a splendid crystalline body, possessing many most interesting properties; but I must confine myself to a short account of its coloured derivatives only.

Carbolic acid, when treated with nitric acid, yields a yellow acid, known as picric acid. This substance can be produced from many other bodies besides carbolic acid, and when first employed for dyeing purposes was generally prepared from the resin of the *Xanthorrhoea hastilis*, but now, owing to the cheapness and purity of carbolic acid, I believe it is exclusively used in its manufacture. Picric acid requires care in its preparation, if phenol and strong nitric acid be employed, as the action is very violent. Pure picric acid is of a very pale yellow colour; it is employed principally for silk dyeing, the colour it produces on silk being much darker than that of the acid itself. Picric acid has a very bitter taste, and by some it is said to be a great improvement upon hops, in the manufacture of bitter beer, especially as it has been proposed as a tonic in place of quinine. Picric acid forms beautiful yellow salts, the most interesting being that of potassium. This salt is extremely insoluble in water, and very explosive; it has been proposed as a substitute for gunpowder for charging shells. Picric acid, under the influence of cyanide of potassium, is perfectly decomposed, and changed into a new compound called isopurpuric acid, a substance isomeric with murexide. The potassium salt of this compound is very explosive, and, to avoid danger, it is generally supplied in a moist condition, and mixed with glycerine. It produces a kind of maroon colour upon wool, but I do not think it has been extensively used up to the present.

Runge, when experimenting with the products of the distillation of coal, obtained two compounds, called by him rosolic and brunolic acids, which he regarded as products existing in coal-tar; I think it most probable, however, that these bodies were produced in his process of purification, and did not exist ready formed in coal-tar.

Rosolic acid was afterwards examined by Dr. Hugo Müller, who obtained it from crude carbolate of calcium, which had been exposed to the oxidising action of the air. This process, however, does not yield rosolic acid in quantity, but, in 1861, Kolbe and Schmitt described a method of producing this substance, by heating a mixture of oxalic, carbolic, and sulphuric acids. It is stated, however, that this process was discovered by M. Jules Persoz, in 1859. It is by this method that rosolic acid is now manufactured.

Commercial rosolic acid, commonly called aurine, is a beautiful brittle resinous substance, having a slight green metallic lustre; when pure it may be crystallised, and if pulverised forms a scarlet orange powder. Its solutions are of an orange colour, but change with alkalis to a most magnificent crimson. It has not been found capable of very many applications in dyeing and printing, although it produces very good orange shades, and with magenta it makes a very good scarlet.

The great difficulty in applying rosolic acid to the arts is owing to the easy solubility of its salts in water. It appears to be closely allied to rosaniline, as it has lately been found possible to obtain it from this colouring matter.

When heated with ammonia, in a closed vessel, to 120° or 140° C., rosolic acid permanently changes into a new colouring matter of a crimson shade, called "peonine" or "coralline." It forms beautiful tints upon silk, similar to safflower, provided it is kept slightly alkaline, but if treated with the least quantity of acid the freshness of its colour is destroyed. When heated with aniline this colouring matter undergoes a similar change to magenta, being converted into a blue called azuline. This colouring matter, as well as coralline, was discovered by M. Jules Persoz, and patented by MM. Guinon Marnas and Bonnet in 1862. Azuline, when in the solid state, presents a

coppery coloured surface; it is soluble in alcohol, but difficultly so in water. It is not manufactured now, having been replaced by the more brilliant blues obtained from rosaniline, and described in our last lecture.

We must now turn our attention to another series of coal-tar colours, derived from a beautiful product called naphthaline. You will see it on the table of coal tar products; it is a hydrocarbon containing  $C_{10}H_8$ , and may be obtained in any quantity. It is remarkable for the readiness with which it sublimes, and, like benzol and toluol, it yields with nitric acid a nitro compound called "nitronaphthaline," a beautifully crystalline body, and this, with iron and acetic acid, yields an organic base called "naphthylamine." This base is solid, and beautifully crystalline, but possesses a very disagreeable odour.

Mr. Church and myself obtained from a salt of "naphthylamine" and a mixture of nitrite of potassium and potash, a beautiful substance crystallising in orange needles with a green lustre. It is called by a rather long name, "azodinaphthyldiamine."

This substance is a feeble organic base, and dissolves in alcohol, forming an orange-coloured solution, which changes to a splendid violet colour upon the addition of hydrochloric acid. It has, however, been found useless as a dye, because the purple colour only exists in the presence of free acid, and the orange-colour of the base itself is liable to turn brown when exposed to the light. It would appear probable, however, that azodinaphthyldiamine may become useful as the starting-point for new colouring matters, as I have lately succeeded in producing from it a very promising crimson substance, possessing a considerable affinity for animal fibres.

A very beautiful yellow colouring matter has been obtained by Dr. Martius from naphthylamine, somewhat similar to picric acid, but of a much more intense colour. It is prepared by treating hydrochlorate of naphthylamine with nitrite of potassium; by this means a substance known as diazonaphthol is obtained; this is then heated with nitric acid, and is transformed into the new yellow, chemically known as dinitronaphthol. This substance is commercially called Manchester yellow. It possesses the properties of an acid. The commercial compound consists of a beautifully-crystalline calcium salt, soluble in water, and dyeing silk or wool a magnificent golden yellow colour.

Owing to an increasing demand for benzoic acid, experiments have lately been made with a view of obtaining it from naphthaline instead of gum benzoin, &c. For this purpose experiments were made with an acid derived from naphthaline, called phthalic acid, which, when carefully heated with lime, is found capable of yielding benzoate of calcium, from which benzoic acid can be prepared. But as in these processes secondary compounds are formed, which interest us this evening, I will briefly describe the process employed for obtaining these various substances.

First of all, naphthaline is heated with a mixture of chlorate of potassium and hydrochloric acid; in this way a mixture of chloronaphthaline and bichloronaphthaline is obtained. These products are then heated with nitric acid, and yield a mixture of phthalic acid, and a substance called the chloride of chloroxynaphthyl. The phthalic acid is converted into the calcium salt, and heated with slaked lime to a temperature of 350° or 370° C., to convert it into a benzoate.

It is, however, the chloride of chloroxynaphthyl which interests us now. This substance, when heated with an alkali, yields the salts of an acid called chloroxynaphthalic acid, which may be obtained in a free state by means of hydrochloric acid. When pure, chloroxynaphthalic acid is a pale yellow crystalline powder, forming beautiful compounds with baryta, zinc, and copper. It dyes wool a scarlet colour. The great interest of this substance consists in its supposed relationship to alizarine, the colouring matter of madder, the only difference in composition of chloroxynaphthalic acid and alizarine being



in the former containing an equivalent of chlorine in place of hydrogen, thus:—



Many endeavours have been made to remove this chlorine, and to put hydrogen in its place, with the hopes of producing alizarine; but, up to the present time, no definite results have been obtained.

I am inclined to think that, although this relationship of composition exists between these bodies, yet that their chemical nature is quite dissimilar. We generally find that chlorinated bodies have similar properties to those from which they are derived or represent. Chloroxynaphthalic acid, however, does not appear to possess properties similar to alizarine. This acid dyes wool readily without a mordant; alizarine only slightly stains it. When boiled with cloth prepared with alumina or iron mordants, it scarcely produces any change, while alizarine yields intense colours.

This process of preparing benzoic and chloroxynaphthalic acids is carried out on the large scale in France, by MM. P. and E. Depouilly, to whom I am indebted for the specimens of these products shown in this lecture. Some of the chloroxynaphthalates are beautifully-coloured salts, and are used as pigments.

Laurent in his researches obtained a body from naphthaline, called carminaphtha. This product is now claiming the attention of manufacturers, and is said to produce very fine shades of colour upon fabrics.

(To be continued.)

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

*Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

*Comptes Rendus des Séances de l'Académie des Sciences, August 11, 1870.*

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

**Spectrum of the Solar Atmosphere.**—G. Rayet.

**Thermo-Chemical Researches on the Sulphurets.**—M. Berthelot.—This lengthy memoir is divided into the following sections:—Reactions of alkaline sulphides upon solutions of metallic salts; reactions of acids upon alkaline sulphides; reaction of sulphuretted hydrogen upon divers metallic salts; and reaction of acids upon metallic sulphurets.

**Action of Pentachloride and Pentabromide of Phosphorus upon Divers Ethers.**—L. Henry.—This memoir is divided into the following chapters:—Glycollate and lactate of ethyl; diethylic malate and tartrate. The author says that, while hydroxyl, (HO), no matter what be its function (be it that of alcohol, acid, or phenol), is readily replaceable, often even at the ordinary temperature, by an atom of chlorine or bromine, under the action of pentachloride or pentabromide of phosphorus. The methoxyl and ethoxyl are not so acted upon. The author's memoir is too lengthy for further useful abstraction, exceeding even the limits usually permitted for publication of papers in this periodical.

**Analysis of Nadorite, a New Kind of Mineral from Constantine (Algeria).**—F. Pisani.—The author of this paper begins by referring to M. Flajolot's paper on this subject (see CHEMICAL NEWS, vol. xxii., p. 58); and next states that the last-named experimenter has overlooked the presence of chlorine in this mineral. The results of the analysis made by M. Pisani are, in 100 parts—Oxide of antimony, 37.40; oxide of lead, 27.60; lead, 26.27; chlorine, 9.0. Formula,  $(\text{Sb}_2\text{O}_3, \text{PbO}) + \text{PbCl}$ . Nadorite is, therefore, a new and rather remarkable mineral, since it is the first instance that chlorine has been found in a native compound containing antimony. Nadorite is accompanied by a lemon-yellow coloured mineral, which turned out to be an antimoniate and hydrated carbonate of lead.

**Hygienic Use of Phenic Acid.**—Dr. F. C. Calvert.—The contents of this paper are sufficiently well-known, but there is added to it a foot-note from the hand of M. Dumas, who says that phenic acid has been used as disinfectant, on the large scale, since 1865; in the following year, its use was made compulsory wherever any death occurred, and at all funerals. The hygienic use of this substance is, therefore, far longer established in France than in this country, where, according to the author of the paper above alluded to, it has only been introduced since 1867.

**Quantity of Pure Nitrogen given off by Organic Nitrogenous Substances.**—Dr. F. C. Calvert.—This paper contains the results of some experiments on the action of hypochlorous acid upon animal matters. The quantity of nitrogen present in these substances is—For gelatine and albumen, 15.7 per cent; calcine, 15.8 per cent; and wool and silk, respectively, 17.7 and 17.6 per cent. The quantity of nitrogen evolved from these substances by the action of hypochlorous acid varies from 5.391 to 7.81 per cent.

**Maximum of Temperature at Poitiers on the 24th of July, 1870.**—Ch. Contejean.—The author says it very rarely happens that, in this part of France, the temperature exceeds 35° (95° F.) in the shade, and towards the north quarter of the sky; but on the above-named date, the temperature has been, for several hours, 41° (above 106° F.), and during that time the curious phenomenon could be witnessed of a falling of the mercury in the thermometer, if the bulb thereof were touched by the fingers, or placed in the mouth. The sky was quite bright and clear, and the wind N.E. The city of Poitiers (Departement de Vienne) is situated at between 46° and 47° N. latitude, and at about 2° W. of Paris.

**Rainfall on the French Alps.**—V. Raulin.—There are added to this paper a series of tabulated forms exhibiting the results of meteorological observations made at sixteen different localities, varying in height, above sea level, from 2491 to 2113 metres; while, in every single locality, the observations have been carried on for a great number of years. It is curious to learn that, whereas, in the Pyrenees, the annual rain-fall increases with increase of height above sea level, the reverse occurs in the French Alps, where, on the whole, the quantity of rain which falls is less.

**Earthquake in Mexico on the 11th of May last.**—Dr. Chassin.—The author describes, at great length, a series of earthquakes which have taken place from the 11th to the 19th of May last in the western part of the above-named country. That portion where this phenomenon was most active has, it appears, undergone very curious changes. Lake Chicagua has entirely disappeared, leaving a dry soil, with the fish, alligators, and other aquatic animals on it. In other places, Cayula among the number, a new lake has been suddenly formed; old, deep wells, which were dry years since, have become filled with water again, and other wells have run dry. Trees have been uprooted by thousands, and whole villages have disappeared.

**Cotton Respirators.**—Dr. Jouglet.—The author, taking the hint thrown out by Professor Tyndall, has been experimenting on the use of cotton respirators, and states that, by their application, the disease known as miner's anaemia, and also the dangers of the effects of lead, copper, and mercury, to those who have to handle these metals, or work in vapours or dust thereof, may be prevented.

*Annalen der Chemie und Pharmacie, June, 1870.*

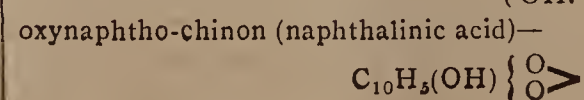
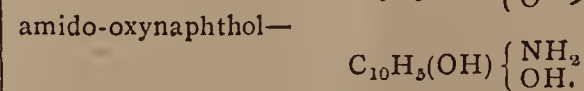
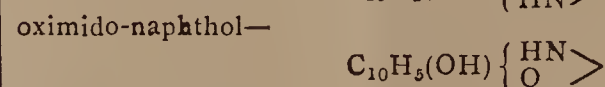
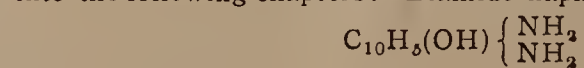
This number contains the following original memoirs and papers:—

**Carbonic Acid Ether of the Glycolic Acid Ether.**—W. Heintz.—This lengthy paper is divided into the following sections:—Carbodi-glucolic acid ether; carbo-glycolic acid ether.

**White Cinchona Bark from Payta.**—O. Hesse.—The author found that this bark contains, beside paytin, so large a quantity of starch that the bark might be used as a fermentable and distillable alcohol-producing material. The paytin is a new alkaloid, readily soluble in alcohol, ether, benzene, and chloroform; difficultly soluble in water, in potassa solution, and ammonia; it fuses at 156°, combines with acids, forming salts and double salts. The formula of paytin is  $\text{C}_{21}\text{H}_{24}\text{N}_2\text{O}$ .

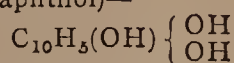
**On Mono-Bromotoluol; and on the Derivation of Isomeric Amido Bases from a Hydrocarbon.**—H. Hubner and O. Wallach.—This paper contains the following divisions:—Crystallised bromotoluol,  $\text{C}_7\text{H}_7\text{Br}$ ; bromo-nitrotoluol,  $\text{C}_6\text{H}_5(\text{NO}_2)\text{Br} \cdot \text{CH}_3$ ; monobromotoluidine,  $\text{C}_6\text{H}_4\text{Br} \cdot \text{CH}_3 \cdot \text{NH}_2$ ; toluidine; sulphate of toluidine; acetotoluidine,  $\text{C}_6\text{H}_4 \cdot \text{CH}_3(\text{NH} \cdot \text{C}_2\text{H}_5\text{O})$ .

**Some Derivatives of Naphthaline which belong to the Chinons.**—C. Græbe and E. Ludwig.—This lengthy treatise is divided into the following chapters:—Biamido-naphthol—





trioxynaphthalin (bioxynaphthol)—



Diamido-Benzoic Acid.—P. Griess.

Constitution of Amygdalin and Amygdalinic Acid.—H. Schiff.

Isomeric Cresols.—L. Barth.

Direct Conversion of the Butyl-Iodide of Fermentation into the Amin-Basis of Trimethyl-Carbinol; and on the Conversion of the Butylamine of Fermentation into Trimethyl-Carbinol.—E. Linnemann.

*Polytechnisches Journal von Dingler*, second number for June, 1870.

The first number for this month has not come to hand; it will be quoted hereafter. This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

Improved Hair Hygrometer.—MM. Hermann and Pfister.—The description, accompanied by engravings, of an instrument to determine the moisture of the atmosphere.

Estimation of the Pyrometric Value of Siliceous Substances.—Dr. C. Bischof.—This paper contains a discussion on the quantity of fluxes which render such substances—as, for instance, fire clay, and mixture of quartz-sand and alumina—fusible to such a degree as will prevent their application to blast-furnaces, puddling-ovens, and the like contrivances. The author tests the materials (native clays, sandstones, &c.) by reducing these substances to an impalpable powder, and mixing therewith from one to twenty times their weight of pure pulverised quartz. These mixtures are kneaded, with water, to a stiff paste, and pressed in prismatic shape, and, after air-drying, exposed to the same degree of heat—a temperature higher than the melting-point of wrought-iron.

Amorphous Silica as a means of Fixing Pigments and Dyes.—Dr. M. Reimann.—The author describes, at some length, a series of experiments made with the view to apply amorphous silica (as obtained by precipitating a solution of so-called water-glass, silicate of soda, or potassa, with an acid, and collecting, washing, and drying the precipitate in the ordinary way) for absorbing the solutions of fuchsine, aniline blue, &c., and to apply the coloured powder so prepared as a pigment for various materials. The author states that glass, first superficially acted upon by hydrofluoric acid, and next mordanted, as is usual for cotton, assumes, when submitted to the processes in use for dyeing fibre, precisely similar colours as that fibre, and that this effect is caused by the amorphous silica contained in the glass and made active by the hydrofluoric acid.

Preparation of Anthracen.—Dr. J. Gessert.—That portion of the distillation of coal-tar commonly called green grease, and used as waggon- and cart-grease, is, according to the author, the material of coal-tar which contains anthracen, and consists chiefly of a heavy oil, naphthaline, and about 20 per cent of anthracen, which, however, is only contained in coal-tar to an amount of from  $\frac{1}{4}$  to 1 per cent. This semi-fluid grease is first placed in a centrifugal machine, in order to expel, mechanically, as much as possible of the oil; the residue is heated to 40°, and pressed, preferably between hot plates. The cake thus obtained (crude anthracen, containing 60 per cent of that substance) is purified by boiling with light tar-oil (coal-tar naphtha), or with petroleum naphtha. The pasty mass is again placed in the centrifugal machine, to remove the last traces of heavy oil, and the material next submitted to sublimation. In order to test the green grease for the quantity of anthracen from 5 to 10 grms. of that substance are taken, placed between folds of filtering-paper, and pressed between hot plates; the remainder of the substance is repeatedly boiled with alcohol, washed with cold alcohol upon a filter, and next dried and weighed. The fusion-point of the mass should be, as near as possible, 210°. The author says that sulphide of carbon is not well suited for the purification of anthracen, because that substance is too readily soluble in that fluid. 100 parts of alcohol dissolve, when cold, 0.6 parts of anthracen; 100 parts of cold benzol dissolve 0.9 parts of anthracen; and 100 parts of sulphide of carbon dissolve 1.7 parts of anthracen.

Paper, and the Raw Materials it is made of.—Dr. H. Grothe.—This paper is a lengthy memoir and review on the treatise written on this subject by M. Z. Orioli, to whom has been awarded the prize of the Société Industrielle de Mulhouse, which Society has published the treatise alluded to.

New Method for the Preparation of Woody Substances into Pulp suitable for Making Paper.—O. Krieg.—Chiefly a review of what has been done in the United Kingdom as regards making paper from straw, esparto grass, wood, and other materials.

Detection of Sulphate of Soda in Carbonate of Soda.—Dr. Hager.—The author states that it has become customary (at least in Germany) to mix, for the retail trade, crystallised sulphate of soda with the ordinary crystallised carbonate. In order to detect this fraud, the author advises to select a few crystals, or small lumps; place these in a basin, or suitable capsule, so that the lumps are about  $\frac{1}{2}$  centim. apart, and then to pour on them a solution of from 1 to 2 parts of corrosive sublimate in 100 parts of 80 per cent alcohol. The crystals of carbonate of soda will become coloured reddish brown by this reagent, while the sulphate of soda remains colourless.

Quantity of Carbonic Acid contained in the Air of School-Rooms.—Dr. Breiting.—The author made a series of fourteen experiments, beginning at 7.45 a.m. and continued to 4 p.m., in a room of 251.61 cubic metres' capacity and containing sixty-four children. The quantity of carbonic acid contained in the air of that room during these experiments varied from 2.21 to 9.36 per cent, while free open air con-

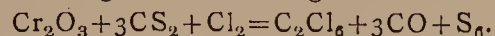
tains 4-10,000th of that gas; and a quantity of 1 per cent of the same gas present in air is considered injurious to health.

*Moniteur Scientifique*, No. 327, August 1, 1870.

This number contains the following original papers relating to chemistry and allied sciences:—

New Method of Treating Native Sulphurets, Antimoniurets, Arseniurets of Copper, Lead, Nickel, Silver, and Iron.—Dr. E. Kopp.—The author first alludes to the mineral resources of Italy, which appear to be far greater and of more value than is generally known or suspected. The difficulty of rendering these treasures industrially available is the great scarcity of fuel. Under these conditions, a series of experiments have been made, to ascertain whether it might be possible to apply cheap and readily-accessible chemical reagents, so to act upon the above-named minerals (without simultaneously affecting the gangue) as thereby to render them in a state fit for being readily converted into metals. As reagents available for the purposes alluded to, the author has found common salt, chloride of iron, and hydrochloric acid readily to suit the requirements. Among the practical suggestions found in this paper, is the fact, that the most economical method to extract the small quantity of copper present in previously-burnt pyrites, consists in first exposing the burnt substance for a time to air and moisture, and then to pour over the material a solution of common salt. A small addition of hydrochloric acid is very useful; the copper thus becomes converted into a soluble chloride.

Preparation of Chromic Chloride.—F. Serena.—Instead of preparing this substance by the method described in books on chemistry, the author makes chlorine gas, previous to coming into contact with pure red-hot oxide of chromium, pass through chloroform or sulphide of carbon. By the use of the last-named substance, the reaction is accomplished according to the following formula—



Towards the end of the operation, it is best to withdraw the flask containing the sulphide of carbon, and to continue the current of chlorine gas strongly.

Utilisation of Nitrate of Soda in the Metallurgy of Nickel and Soda.—R. Wagner.—The author describes, at great length, the method of operations of applying nitrate of soda to the purification of a secondary metallurgical product, a matter consisting, in 100 parts, of—Nickel, 25.22; copper, 37.65; iron, 10.58; sulphur, 26.45. This matte was first fused with the salt just named, and next re-melted with a mixture of 15 per cent of its weight of equal parts of nitrate and carbonate of soda, with the result that a metallic alloy was obtained consisting, in 100 parts, of—Nickel, 40.93; copper, 58.64; iron, 0.25; sulphur, 0.18. The lixiviation of the scoriæ yielded crystallised sulphate of soda. An arseniuret of nickel, containing, in 100 parts—Nickel, 48.20; cobalt, 1.63; bismuth, 2.44; iron, 0.65; copper, 1.93; arsenic, 42.08; sulphur, 3.07. By fusing this mineral with a mixture of 5 per cent of nitrate of soda and 10 per cent of anhydrous carbonate of soda, the author found that almost all the arsenic was eliminated as arseniate, and was mixed with the other impurities in the scoriæ. The regulus obtained consisted, in 100 parts, of—Nickel, 90.67; copper, 4.05; cobalt, 0.30; arsenic, 0.62; loss, 0.36.

On Vinage.—(The continuation of the paper quoted, with names of authors, in *CHEMICAL NEWS*, vol. xxii., p. 60.)—This portion of this very lengthy memoir is divided into the following sections:—The origin of the alcohols employed for the vinage; the object, or aim, of vinage, and the proportion of alcohol added to wine; the advantage and disadvantage of vinage; the modification vinage brings on in the composition of wine; and the answer to the question whether vinage is a fraud which ought to be prohibited, and, if so, by what means is it possible to improve wines and make them fit to be kept without altering their natural goodness or changing their composition.

*Berichte der Deutschen Chemischen Gesellschaft zu Berlin*, No. 11, 1870.

This number contains the following original memoirs and papers:—

Molecular Volume of Chinon.—Dr. A. W. Hofmann.—The author has experimented on the vapour density of chinon, and has found the following results:—

	Theory.	
	$\text{C}_{12}\text{H}_8\text{O}_4$	$\text{C}_6\text{H}_4\text{O}_2$
Weight of gas volume in reference to hydrogen	108.0	54.00
" " " " " air	7.5	3.75

The author states that chinon is undoubtedly a monobenzol derivative.

Methyl-Aldehyd.—Dr. A. W. Hofmann.—The contents of this lengthy paper, full of formulæ, bear chiefly upon the determination of the vapour density of the solid methyl-aldehyd, by means of some peculiar compounds of the last-named substance with sulphur. There is added to this memoir the following PS.:—

Contribution to our Knowledge on the Sulphaldehyd of the Ethyl Series.

Some Observations on the Camphor Group.—W. Schleich.—This memoir is divided into the following chapters:—Action of alkalis on camphoric acid anhydride; on a nitrited derivative of camphor; on a derivative of camphor containing sulphur.

Constitution of Silicic and Hydrofluoric Acids in Aqueous Solutions.—J. Thomsen.—The author has experimented thermically



on the phenomena of neutralisation and basicity of the acids above-named, and states—The formula of silica in aqueous solution is that ordinarily accepted,  $\text{Si}(\text{OH})_4$ ; hydrofluoric acid, in aqueous solution, behaves towards silicic acid as a monobasic biatomic acid, having as formula— $\text{H.Fl}_2\text{H}$ ; the normal compound, the product of the reaction of silicic and hydrofluoric acids upon each other is— $\text{Si}(\text{Fl}_2\text{H})_4$ .

**New Method of Preparation of Organic Chlor-Bromine Compounds.**—L. Henry.—The author describes some experiments to prove the possibility of using chlor-iodethylen and chlor-iodhydride for the purpose of obtaining the organic compounds above-mentioned, but an excess of bromine is necessary for the full reaction.

**On Tribromhydride.**—L. Henry.—This paper is chiefly a reply to M. Berthelot, who had criticised the author's experiments and researches on this subject.

**Contribution to our Knowledge of Crotonic Acids.**—A. Kekulé.—This lengthy memoir is chiefly a critical review of the labours of a large number of scientific chemists on this subject, and contains such of the author's researches as may serve to bring about harmony and clear away doubts existing on this subject. The memoir is accompanied by diagrams and a large number of quotations from various scientific periodicals.

**Curcumine, the Pigment of Turmeric Root.**—F. W. Daube.—The author begins by stating that the substance hitherto known as curcumine, and usually obtained from the drug known as turmeric, by means of exhausting it with alcohol, is not pure curcumine, but a mixture of that body and various resinous matters. The preparation of curcumine is described as follows:—The previously coarsely-pulverised drug is submitted to a process of steaming, in order to remove the essential oil. The residue is next washed with boiling-water as long as that fluid becomes coloured; the material is then thoroughly dried, and next exhausted with boiling benzol (this fluid is only a very indifferent solvent for curcumine, since 1 part of the latter requires 2000 of the former for solution; but the use of benzol is, after all, indispensable, since it is the only fluid which leaves the resinous matter of the drug undissolved). On cooling, the hot benzol deposits crude curcumine, which is further purified, first, by being pressed between folds of blotting-paper, and next being dissolved in alcohol. The alcoholic solution is filtered, in order to separate a small quantity of a yellow-coloured flocculent matter. The filtrate is next precipitated with an alcoholic solution of acetate of lead. The ensuing precipitate is collected on a filter, washed with alcohol, next diffused through water, decomposed by sulphuretted hydrogen, and the mixed sulphide of lead and curcumine collected on a filter, washed, dried, and next exhausted with alcohol, which dissolves the curcumine. This solution being left to spontaneous evaporation, leaves curcumine in crystalline state, as a body, readily soluble in alcohol and ether, also in alkalies; the solution, in that case, exhibiting a bright red-brown colouration. Curcumine is insoluble in water; concentrated mineral acids (sulphuric and hydrochloric) dissolve it, but also alter it; it combines with lime and baryta, forming insoluble red-brown coloured compounds; its combination with metals are all insoluble in water; the lead compound is of a brick-red colour. Curcumine fuses at  $165^\circ$ , does not sublime, but is decomposed when further heated. The formula of curcumine is  $\text{C}_{10}\text{H}_{10}\text{O}_3$ , and that of its lead compound  $\text{C}_{20}\text{H}_{18}\text{PbO}_8$ .

**Derivatives from Albumen Compounds.**—W. Knopp.—This paper contains an as yet imperfect and preliminary notice on the action of sulpho-vinic acid upon albumen.

**Derivatives of Hexyl-Hydride (Hexylwasserstoff,  $\text{C}_6\text{H}_{14}$ ).**—C. Schorlemmer.

**Peculiar Formation of Cetyl-Alcohol.**—C. Schorlemmer.—When a mixture of sebac acid and caustic baryta are submitted to dry distillation, there is formed, beside other products, a solid body, which, after having been purified, and re-crystallised by means of alcohol, yielded, by elementary organic analysis, results leading to the formula  $\text{C}_{16}\text{H}_{34}\text{O}$ . The substance in question fuses at  $49^\circ$ , and possesses all the properties of cetyl-alcohol.

**On Curcumine.**—Iwanof-Gajewsky.—This author, who has been investigating this subject simultaneously with, and independently of, the author of a paper on this subject alluded to above, states that sulphide of carbon takes up, from turmeric, an oil containing, beside oxygen, 80.2 per cent of carbon and 10 per cent of hydrogen. This oil boils at from  $240^\circ$ — $260^\circ$ . The drug having been next treated with ether, yields, to that solvent, curcumine, as yellow-coloured crystalline body,  $\text{C}_4\text{H}_4\text{O}$ , fusing at  $172^\circ$ ; the drug contains, moreover, another pigment and an alkaloid.

*Zeitschrift für Chemie von Beilstein, No. 12, 1870.*

This number contains the following papers and memoirs:—

**Substance Present in Bran which Yields Furfurol.**—M. Gudkow.—The chief results of the author's researches are:—Furfurol is formed by a peculiar material present in bran to an amount of from 15 to 20 per cent, and chiefly contained in the husks of the grain, to which it imparts its elasticity. This furfurol-producing matter is insoluble in water, but soluble in very dilute sulphuric acid and in caustic potassa. When boiled with very dilute sulphuric acid, this substance is converted into a peculiar saccharine matter, which, on being treated with stronger sulphuric acid, yields, by distillation, furfurol. When cattle are fed with bran, the material which yields furfurol passes into their faeces. The author quotes a series of results of analysis of bran made by various chemists and at different periods of time; the quantity of woody fibre, recorded in these analyses as present in bran, varies from 4.1 to 34.6 per cent, while the quantity of starch and gum is put down at figures varying from 21.7 to 61.5. From these discrepancies,

coupled with the fact that none of the analysts mention the material which yields furfurol, the author concludes that a portion of the quantities recorded as woody fibre, and a portion of that recorded as starch, ought to be quoted as furfurol-producing matter—a substance which does not simply occur in bran, but also in oil-cake, madder-root, and other plants.

**Four Isomeric Ethyl-Naphthol-Sulpho Acids.**—B. Maikopar.—The author describes briefly:—a ethyl-naphthol-sulpho acid,



and its baryta and potassa salt, the former fusing at about  $57^\circ$  and becoming thereby decomposed; the  $\beta$  acid, and the salts it forms with the same bases; and also the  $\gamma$  and  $\delta$  acids; with some of their salts.

**Bromonitro- and Bromamido-Benzol, and on the Position the Hydrogen of Benzol Occupies.**—H. Hubner and M. Alsberg.—The authors say that they undertook these researches chiefly with the view of ascertaining whether the position of the 6 atoms of hydrogen contained in benzol is the same. For this purpose they have studied the bromonitrobenzols, of which they describe an  $\alpha$  and  $\beta$  compound; the formula of the former being a  $\text{C}_6\text{H}_4\text{BrNO}_2$ ; further,  $\alpha$  and  $\beta$  bromamidobenzol, the former a solid substance, crystalline, fusing at  $64.5^\circ$ ; the latter, formula  $\beta \text{C}_6\text{H}_4\text{BrNH}_2$ , a fluid which, when submitted to the influence of great cold, becomes solid; and, once solidified, remains solid, even up to  $31^\circ$ . The authors also describe, somewhat categorically, a series of salts; and, as regards the position of the hydrogen atoms of benzol, they come to the conclusion that the position and quantivalence of these atoms is the same for each of them.

**On Agoniada and Agonidine.**—Dr. P. Peckolt.—The author has extracted from the agonia bark (*Plumeria lancifolia*), a tree indigenous to the Brazils, the bark being largely used in that country as febrifuge; a substance which he calls agonidine; a crystalline matter, devoid of smell, of a very bitter taste, difficultly soluble in ether but more readily so in boiling alcohol and boiling water, does not sublime on being heated, is soluble, also, in solution of caustic potassa; in ammonia and in concentrated sulphuric acid, the latter solution is at first of a golden-yellow colour, but turns gradually green. Upon the addition of nitric acid to the sulphuric acid solution of agonidine, a yellow-coloured flocculent matter is separated; this substance is a glucoside identical with arbutine, and contains no nitrogen. The formula of agonidine is  $\text{C}_{10}\text{H}_{14}\text{O}_6$ .

## NOTES AND QUERIES.

**Condensing Hydrochloric Acid Gas.**—What time, and space of condenser, is required to condense the HCl gas produced from 896 lbs. ordinary common salt?—SALT.

**Waterproofing.**—"M. A. S." is referred to Ure's "Dictionary of Arts, &c.," vol. iii., and to Cooley's "Cyclopædia of Practical Receipts." Both works may be inspected at the Library of the Commissioners of Patents.

**Estimation of Alkalies in Silicates.**—Can any of your readers inform me where to find Dr. Lawrence Smith's recent method of estimating the alkalies in silicates? I would suggest that a description of this process will be of value to a great many of your readers.—ANALYST.

**Carbolic Acid.**—(Reply to "Fitzetienne.")—Since the boiling-point of carbolic (phenic) acid is  $188^\circ$ , it is clear that it will be found in the products distilled over between  $150^\circ$  and  $200^\circ$ . The oily liquid, distilling over at that temperature, should be well mixed with a solution of caustic soda, which combines with the carbolic acid, forming a compound which may be readily decomposed by any strong mineral acid. To be brief, the process comes to a preparation of carbolic acid, carried on so carefully as to render it suitable for ascertaining quantities. For full particulars you are referred to Schützenberger, "Traité des Matières Colorantes," vol ii., pp. 4, 5.

**Brewing Queries.**—Can any of your readers supply me with either references or directions for brewing household beer—say 20 gallons at a time. I can manage the malt extremely well; but on each occasion when I have tried sugar, it never fines, or requires several months, and in either case has a sickly taste. The last may, perhaps, arise from using loaf sugar. I may add that I have tried the directions given by Donovan, in his "Domestic Economy," and also by boiling the sugar and hops, and fermenting in the usual way, "setting on" at about  $25^\circ$ — $70^\circ$ . (1) What are the relative values of malt and sugar? I have been accustomed to boiling down to  $25^\circ$  for the malt, and in sugar-beers calculating the sugar same strength. (2) How can I overcome the disposition of the sugar-beer holding in suspension the albumen, and get it clear and bright in a few days?—T. GREGSON.

**Analysis of German Silver.**—A good method of separating copper, nickel, and zinc, is to dissolve the alloy in hydrochloric acid containing a few drops of nitric acid, and precipitate the copper from the slightly acid solution in the form of sub-sulphocyanide of copper. The liquid, after being filtered and reduced, by evaporation, to a small bulk, is treated by excess of caustic potash, and then by hydrocyanic acid, until the precipitate which is at first formed is completely re-dissolved with a yellow colour. In this liquid, which contains the double cyanides, the zinc is precipitated in the state of sulphide, by means of protosulphide of potassium (not sulphide of ammonium). After some hours' digestion, and when the precipitate is completely deposited, it is filtered off, and, after boiling the liquid with *aqua regia*, the nickel is precipitated as oxide by caustic potash. This oxide must be calcined after it is dried.—F. WÖHLER.



# THE CHEMICAL NEWS.

VOL. XXII. No. 560.

## ON THE ALKALINITY OF CARBONATE OF LIME.

By W. SKEY,  
Analyst to the Geological Survey of New Zealand.

CARBONATE of lime is described in chemical works as neutral to test-paper, but this scarcely agreeing with the results of observations I have had to make upon this point in the course of other investigations, I beg to give these results, which are as follows,—

1. Carbonate of lime, prepared by igniting pure oxalate of lime in a close crucible, at a dull red-heat, gives an intense alkaline reaction with reddened litmus-paper, after moistening with distilled water, or after re-ignition with pure carbonate of ammonia.

2. Carbonate of lime, prepared directly from chloride of calcium and bicarbonate of soda, by admixture of their aqueous solutions, and washing the ensuing precipitate till all the soda was removed, gave the same reaction with test-paper.

3. Limestone, shells (calcareous), calc-spar crystals, and arragonite, are all strongly alkaline to test-paper (at least, the samples I have tried were), the powder of any of these substances, washed with distilled water for many days, does not seem to lose any of this alkalinity.

Lastly (and, I think, conclusively), precipitated carbonate of lime, prepared by either of the above processes, when agitated with weak hydrochloric acid, in successive quantities, until gradually reduced to a minute proportion of its original bulk, still manifests this reaction to an eminent degree; indeed, the solution could not be rendered permanently acid till the whole of the carbonate was dissolved.

It seems impossible, under these circumstances, to attribute this reaction to the accidental presence of free magnesia or lime, sub-carbonate of lime, or alkaline carbonates, in the precipitate; this reaction may therefore, I think, fairly be attributed to the carbonate of lime.

## NOTE ON SOME NEW DERIVATIVES OF COUMARIN.

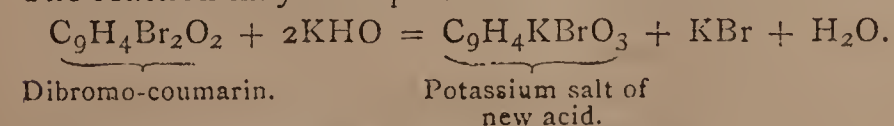
By W. H. PERKIN, F.R.S.

IN a paper read at the Chemical Society in May last,\* I described some new bromine derivatives of coumarin, viz.,—

Dibromide of coumarin	.. ..	$C_9H_6O_2, Br_2$
Bromo-coumarin	.. ..	$C_9H_5BrO_2$
Dibromo-coumarin	.. ..	$C_9H_4Br_2O_2$

and stated that the two latter compounds, when treated with potassic hydrate, yielded the salts of new acids. At that time I thought it possible that these products might be derivatives of coumaric acid. A more extended study of this subject, however, has shown that this is not the case.

When dibromo-coumarin is boiled with aqueous potassic hydrate it rapidly dissolves; the resulting solution, however, becomes, in a short time, a magma of crystals. These consist of the potassium salt of a new acid. Potassic bromide is also formed in large quantities. The reaction may be expressed thus:—



\* CHEMICAL NEWS, vol. xxi., p. 247.

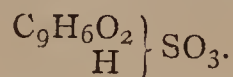
The acid obtained from this potassium salt is crystalline, and possesses a very bitter taste; its formula is—



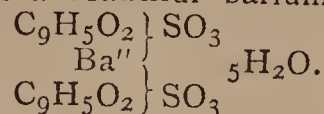
Bromo-coumarin behaves in a similar manner when heated with potassic hydrate, producing a crystalline salt and potassic bromide. The acid obtained from this has not yet been analysed. It probably possesses the formula  $C_9H_6O_3$ .

In the preparation of coumarin from hydride of salicyl it will be remembered that the hydride of sodium salicyl is heated with acetic anhydride; by modifying this process, and employing the sodium derivative of bromo-salicyl in place of that of salicyl, I have obtained a new bromo-coumarin differing entirely from that produced by the action of bromine on coumarin. It fuses nearly  $50^\circ C$ . higher, and although soluble in boiling potassic hydrate, is not decomposed by this alkali under ordinary circumstances. We have now, therefore, two monobromo-coumarins.\*

Coumarin, when treated with fuming sulphuric acid, dissolves, forming a sulpho-acid, having the formula—



The acid crystallises in brilliant octahedra, which, when removed from their mother-liquor, rapidly become opaque. It forms a beautiful barium salt containing—



When heated strongly with sulphuric acid coumarin gives a disulphoacid,  $C_9H_6O_2, 2SO_3$ .

None of the derivatives of coumarin I have examined appear to have any tendency to unite with water and form derivatives of coumaric acid.

## ON THE COMBINATIONS OF CARBONIC ANHYDRIDE WITH AMMONIA AND WATER.†

By EDWARD DIVERS, M.D., F.C.S.

(Concluded from p. 75.)

AMMONIUM-CARBAMATE heated to  $59^\circ$  or  $60^\circ$  furnishes vapour of the full tension, but it also volatilises at ordinary temperatures. It has a four-volume vapour, and this is the case even at ordinary temperatures, according to Bineau. It is, therefore, decomposed in volatilising into carbonic anhydride and ammonia. Further evidence of this is afforded by the fact that the vapour of carbamate may cool down to a much lower point than that at which it is formed before it condenses.

Rose has pointed out the following reactions of the carbamate as distinguishing it from the carbonates of ammonium:—It is not perceptibly affected by dry hydrochloric acid in the cold, and, warmed in the acid, is decomposed without liberation of water; in dry chlorine it is not affected at first, but is slowly decomposed without liberation of water; it assumes in the cold a pale yellowish colour when placed in sulphurous anhydride; it does not form water when heated in sulphuretted hydrogen, and it yields carbonic anhydride *without effervescence* when the vapours of sulphuric anhydride are passed over it. Besides these, it has a special reaction in solution with calcium chloride; when mixed with anhydrous calcium chloride, it can be expelled by a gentle heat, leaving the chloride

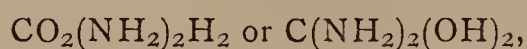
\* Dr. H. Bäsecke by employing the sodium derivative of the hydride of chlorosalicyl in a similar manner has obtained a chlor-coumarin possessing properties analogous to those of this new bromo-coumarin.—*Ann. d. Chem. u. Pharm.*, April, 1870.

† Abstract, by the Author, of a paper communicated to the Chemical Society.

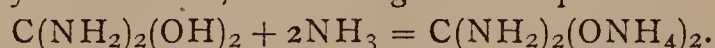


unchanged; it does not melt or become moist when heated; and it dissolves freely in strong ammonia water.

The constitution of the carbamate is almost certainly that indicated by its name, and represented by the formula— $\text{CO}_2(\text{NH}_2)(\text{NH}_4)$ . But no metallic carbamates have as yet been obtained. However, by mixing a very concentrated ammoniacal solution of ammonium carbamate with a saturated solution of calcium chloride, a precipitate may be obtained which is soluble in water, though the solution almost immediately deposits chalk. This precipitate proves, on analysis, to be either calcium carbamate or a double carbonate of calcium and ammonium; which of the two cannot be decided because of the presence of water and other impurities. Ammonium carbamate may be represented as an orthocarbamic acid, thus—

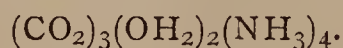


but there is no evidence as yet to support this view of its constitution, unless it be that afforded by the fact that ammonia prevents the passage of the carbamate into carbonate, which may be supposed to be due to the union of the ammonia with this acid to form an orthocarbamate slightly more stable, according to this equation—



*The "Carbonate of Ammonia" of Commerce.*

In the main, the published analyses of this substance show that the samples examined had about the composition expressed by the formula—

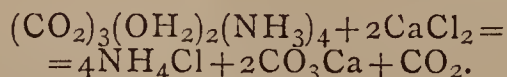
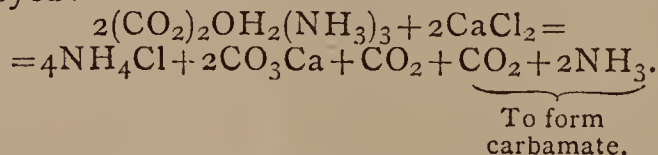


Samples of the carbonate at present in commerce, obtained from various sources, have proved to be of very uniform composition (with one special exception); this, however, is not expressed by the above formula, but by the simpler one—



The percentage numbers obtained agree closely with the calculated numbers, except that they indicate the presence of 1 or 2 per cent additional water and a slight excess of ammonia, but to an extent quite immaterial so far as the determination of the atomic composition is concerned.

Several proofs, other than analytical, can be adduced to show that the carbonate now in commerce differs from that most generally in commerce formerly. One is that, as has been already mentioned, ammonium carbamate condenses out of the products obtained by distilling together the carbonate and anhydrous calcium chloride. The following equations show that this can only take place when, of the two carbonates, that now in commerce is employed:—

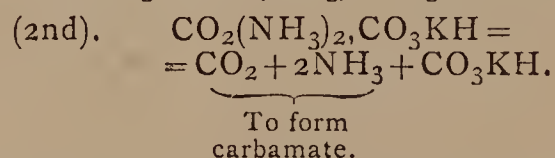
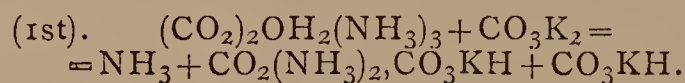


The single exception observed to the uniformity in composition of the commercial carbonate was the occurrence of a layer of *acid carbonate* adhering to a layer of the usual carbonate. It was crystalline, almost devoid of ammoniacal taste and smell, and was permanent on exposure. An instance of the occurrence of the acid carbonate in commerce was noticed by Phillips fifty years ago. It has already been mentioned that the acid carbonate can readily be obtained in this form by the slow distillation of its ordinary form.

The ordinary commercial carbonate, exposed to the air, loses a proportion of its weight, corresponding to that calculated from the formula now found for it, on the assumption that the carbamate in it volatilises and the acid carbonate remains. It dissolves in 4 parts of water at 15°, so that it and the half-acid carbonate both possess solubilities which seem to directly depend upon the amount of acid carbonate they each contain. A warm saturated

solution cooled, deposits crystals of acid carbonate; the mother-liquor warmed with fresh commercial salt again deposits acid carbonate, and the same thing will occur several times on repeating these operations; at length, the mother-liquor, warmed with fresh commercial carbonate, deposits crystals of the half-acid carbonate, and the same thing also occurs several times on repeating the operations; then the mother-liquor from one of these crops, which is a very concentrated solution and contains to one atom of carbonic anhydride more than two of ammonia, deposits gradually a considerable quantity of large crystals of the normal carbonate; lastly, if, instead of waiting for these crystals to form, the normal carbonate is precipitated by passing a current of ammonia gas through the mother-liquor kept cold, the salt remaining in solution appears by its reaction with calcium chloride to be—at least, a large proportion of it—the ammonium carbamate.

The commercial carbonate heated with anhydrous potassium carbonate evolves large quantities of ammonia at a temperature of 50°–60°; when this evolution has nearly or entirely ceased, and the heat is carried to 65°, carbonic anhydride and ammonia escape in the proportion in which they form carbamate, and acid potassium carbonate remains behind. Two reactions, therefore, occur; firstly, a combination of carbamate with acid potassium carbonate is formed, and then this is decomposed, thus:—

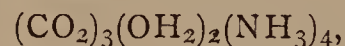


When calcium chloride is used instead of potassium carbonate, the carbamate-forming gases come off below 65°, and this fact, besides that of the volatility of the uncombined carbamate, affords further proof that, when potassium carbonate is used, the carbamate is held in chemical combination with acid potassium carbonate. When the solid hydrated calcium chloride of commerce, which contains about two atoms of water to one of the chloride, is mixed in powder with the commercial carbonate, the mixture has no smell, soon grows warm, swells up, evolves large volumes of carbonic anhydride, and, after gentle heating, consists of chalk and ammonium chloride, together with any excess of either substance used. Regarded as a single substance, the commercial carbonate is best represented as a double salt of carbonic and carbamic acids with ammonium, thus:—

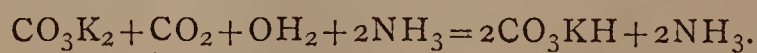


*Products of the Distillation of Sal-Ammoniac with Chalk, with Potassium Carbonate, and with Sodium Carbonate.*

It is always stated that the products of the distillation of sal-ammoniac and chalk are the substance



water, and free ammonia; but this must be done upon theoretical grounds only. When these substances are distilled together, the vapours evolved entirely condense to water and a slightly hydrated carbamate. The formation of the commercial carbonate takes place during the refining process, which consists, as is well known, in re-distilling the products of the first distillation with a little additional water, at a temperature of about 65°. A mixture of sal-ammoniac with either anhydrous potassium or sodium carbonate also yields, when distilled, water and a slightly hydrated carbamate, but some ammonia escapes in the first stage of the operation. This arises from some of the undecomposed alkaline carbonate fixing carbonic anhydride and water, thus:—



When pearl-ash is distilled with fully its equivalent of

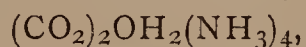


sal-ammoniac and with aqueous alcohol, as in preparing *spiritus ammoniæ aromaticus* (Ph. Lond.) the distillate, as has long been known, is a solution of normal carbonate or equivalent in composition to it. But the first and more alcoholic portions, collected separately, soon deposit crystals of the half-acid carbonate, the mother-liquor being left basic or with more than two atoms of ammonia in it to one of carbonic anhydride. By following the directions of the British Pharmacopœia, and using the commercial carbonate of ammonia and water of ammonia in place of pearl-ash and sal-ammoniac, similar results are obtained.

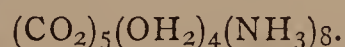
*Products of the Distillation of the Commercial Carbonate of Ammonia, of the three Ammonium Carbonates, and of the Ammonio-Magnesian Carbonate.*

When the carbonate of ammonia of commerce is distilled, it is re-obtained as almost the sole product, unless the distillation is carried on exceedingly slowly. In this case some carbamate, mixed with only a little carbonate, is obtained, in the further end of the retort-neck, and also, near the termination of the process, a little of a more hydrated and carbonated product than the commercial carbonate, but the great bulk of the quasi-sublimate is still the commercial carbonate,  $(\text{CO}_2)_2\text{OH}_2(\text{NH}_3)_3$ .

Rose distilled the carbonate formerly in commerce very slowly, and found some of the remote part of the product to have a composition expressed by the formula

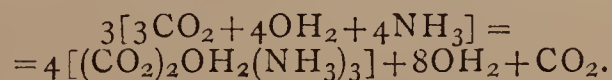
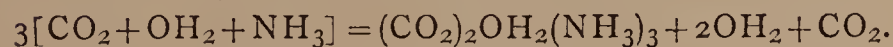
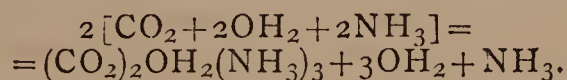


and the bulk of the product to have a composition which is that of the carbonate now in commerce with 5 per cent additional water, though he gave it a formula which would now be written



Products thus obtained are always moist when first formed, so that neither of these need be regarded as a single and definitely hydrated substance. Distilled with alcohol the commercial carbonate yields carbamate and water.

When the normal carbonate of ammonium is distilled very slowly the products are the carbamate and water, and when the acid carbonate is similarly distilled the product is the acid carbonate again; but when either the normal, the acid, or the half-acid carbonate is distilled more rapidly, partial condensation only of the products takes place, and in such a way that the carbonate of commerce is formed, according to the equations—



It has already been mentioned that the half-acid carbonate can be obtained by distilling the ammonio-magnesian carbonate. This, however, is probably a secondary product. The true products appear to be water, carbamate held in solution in the water and rapidly becoming hydrated, and, towards the end of the distillation, some acid carbonate.

*The Single or Chemical Substances that are Formed by Condensing Mixtures of Carbonic Anhydride, Ammonia, and Water.*

All compounds of carbonic anhydride with ammonia and water are decomposed into these substances when they are heated. The products of their distillation are, therefore, results of these substances combining together.

Ammonium carbamate is one of the single or chemical substances formed from a mixture of carbonic anhydride, ammonia, and water. The conditions for its formation appear to be the presence of the ammonia in the proportion of at least two atoms of ammonia to one of the carbonic anhydride and a little water in the liquid state.

Acid ammonium carbonate is another single substance formed from the above mixture. The condition for its formation appears to be the introduction of water-vapour and ammonia in atomic proportions into carbonic anhydride so slowly that the water is never in sufficient quantity to pass its point of maximum density at the temperature of the receiver, and therefore to condense to the liquid state.

Commercial carbonate,  $(\text{CO}_2)_2\text{OH}_2(\text{NH}_3)_3$ , is most probably a third, and the only other single substance formed from the above mixture. The grounds for considering it to be a single substance are—(1) that it is formed so unfailingly and readily by the distillation of any of the true ammonium carbonates; (2) that it can be distilled, and its products again readily condensed to a substance of the same composition; (3) that its composition, when prepared under varying conditions, is closely in accordance with the calculated numbers; (4) that its composition is relatively a very simple one; (5) that ammonium carbamate combines apparently with acid potassium carbonate; and (6) that no other products can be prepared by distillation of uniform composition but this substance, the carbamate, and the acid carbonate, and be re-distilled and condensed into products of the same composition again.

The conditions which seem to be necessary to the formation of the commercial carbonate are—(1) the cooling of a mixture of two volumes of carbonic anhydride and three volumes of ammonia in presence of at least the calculated quantity of water; or (2) the cooling of a mixture of more than two volumes of carbonic anhydride to three of ammonia in presence of at least enough water, provided that some of this is in the liquid state; or (3) the cooling of a mixture of less than two volumes of carbonic anhydride to three volumes of ammonia in presence of enough water in the state of vapour at the temperature at which they combine.

## ON SUPERSATURATED SOLUTIONS.\*

THE following paper by Mr. Grenfell appeared in *Nature* for the 4th of August, 1870:—

The following experiments may be found interesting from their bearing on the latest theories advanced on the subjects on supersaturation and the so-called inactive state of bodies. Professor Tomlinson's theory is that a supersaturated solution adheres as a whole to a chemically clean surface, but that a differential adhesion takes place in presence of a chemically unclean surface, because the salt or gas adheres to such a surface while the liquid does not; the former is consequently liberated. The presence or absence of grease is then stated to constitute chemical uncleanness or cleanness. If a greasy surface can be rendered inactive, it is clear that both these propositions cannot be true; either grease is not of itself a cause of uncleanness, or unclean surfaces are not necessarily active ones. The following experiments prove that the fats may be rendered inactive by the same processes which are applied to rods of glass or metal.

1. A bit of composite candle was melted with a very little alcohol; a glass rod was dipped in, allowed to cool, passed through flame of a Bunsen's burner, and a drop of melted fat deposited on surface of supersaturated solution of zinc sulphate. The fat solidified without affecting the solution even on prolonged agitation. A crystal of the salt caused instant solidification.

2. Same solution boiled remained supersaturated for a fortnight with a crust of fat on the top.

3. Ordinary tallow treated as No. 1. Inactive in solution of sodic sulphate solution; touched with finger, crystallised at once.

4. Lard cleaned simply by melting on rod passed through

\* Communicated by C. Tomlinson, F.R.S.



flame, allowed to cool, stirred in solution of sodic sulphate. Inactive. Other end of rod active at once,

5. Same solution boiled; cooled, stirred with rod, treated as the last, and left exposed to the air for 15 minutes. Did not crystallise. This experiment is interesting, as showing that greasy substances are not specially liable to be made active by exposure to ordinary air.

6. Some tallow was melted in a test-tube without precautions of any kind, and while melted was poured to the depth of half an inch on to solutions of ferrous, cupric, and sodic sulphates. In each case it was inactive. This is conclusive on the point in question.

Theoretical objections have been urged against the definition of chemical uncleanness, and I think this might now be surrendered.

Professor Tomlinson may very likely be right in looking to adhesion for an explanation of these phenomena; at all events, far greater probability seems to attach to this view than to that put forth by M. Gernez, adopted by Jamin, and even, I believe, favourably noticed by the Academy itself; which is that only a crystal of the same salt can induce crystallisation. This latter view is open to the theoretical objection that it necessitates our believing that all salts capable of supersaturation are everywhere and at all times present in the atmosphere. Mr. Tomlinson has shown experimentally that a crystal of the salt properly treated can be inactive in a solution of sodic sulphate.\*

The following experiments show that an atmosphere presumably saturated with the salt may be inactive without any precautions whatever:—

7. Three solutions of sodic sulphate were prepared; a glass rod was dipped in melted tallow and left to cool for five minutes in a bottle of the salt, without touching the salt or the sides of the bottle. Then the three solutions were successively touched with the rod; inactive in all. Rod replaced in the bottle for ten more minutes; then all three again touched. The third crystallised after a minute or two. Rod replaced for fifteen minutes; active only in the second; replaced for fifteen minutes, active in the last. Thus this greasy rod was inactive in one of the solutions after an exposure of thirty minutes, and after being six times dipped in solutions of the salt.

8. An open test-tube, containing a strong solution of sodic sulphate, remained supersaturated for a week suspended in the same large bottle of the salt. The bottle was frequently moved without producing any effect. On removing the cork, the solution crystallised instantly.

On the whole I am afraid we must for the present fall back upon that refuge for the destitute, "Catalytic action."

J. G. GRENFELL.

Birmingham.

The following is Mr. Tomlinson's reply to the above:—

During the last two years, I have made a large number of experiments, in order to ascertain the function of oils and fatty bodies in determining the crystallisation of supersaturated saline solutions. The results of my inquiry are included in a paper which was read before the Royal Society on the evening of the 16th of June last; and I beg to refer to the abstract thereof in the *Proceedings*.

\* It would seem from the experiments of Dr. L. C. de Coppet (which do not appear to be as well known as they deserve) that the treatment adopted by Mr. Tomlinson for rendering the sodic sulphate inactive really changes the salt. Dr. de Coppet finds that a supersaturated solution of sodic sulphate may be prepared by dissolving the anhydrous salt in cold water; and he writes—"I have arrived at the conclusion that the anhydrous sodic sulphate obtained by the efflorescence of the crystals with ten molecules of water, undergo a change of constitution when heated to temperatures superior to 33° or 34°; for the contact of a particle of the effloresced sulphate always causes the crystallisation of a supersaturated solution of this salt, whereas anhydrous sodic sulphate heated above 33° does not necessarily determine the crystallisation."—*Bull. Soc. Vaud. Sc. Nat.*, x., p. 151.

[These experiments render it probable that the so-called supersaturated solutions really contain the anhydrous salt in a state of unstable equilibrium, only requiring a disturbance to cause it to assimilate water, and thus produce a less soluble compound.—*Ed. Nature*.]

I may, however, be permitted to make a few remarks arising out of Mr. Grenfell's paper.

According to my view, a *nucleus* is a body that has a stronger attraction for the gas, or the vapour, or the salt, of a supersaturated solution, than for the liquid that holds it in solution.

Nuclei, with certain limitations, cease to be such when made *chemically clean*.

A body is chemically clean the surface of which is entirely free from any substance foreign to its composition.

Thus, oils and fatty bodies are chemically clean if chemically pure and containing no substance mixed or dissolved that is foreign to their composition.

The limitations above referred to are two—(1) The oils, &c., when chemically clean, do not act as nuclei while in the mass, such as a lens or globule; but these oils, &c., whether clean or not, act powerfully as nuclei when in the form of thin films. (2) A liquid, at or near the boiling-point, is a supersaturated solution of its own vapour; and a *porous* body, such as charcoal, pumice, &c., whether clean or not, is a powerful nucleus in separating vapour.\*

I have, on several occasions, taken the liberty of opposing M. Gernez's views, as to the action of nuclei. He supposes (1) that supersaturated gaseous solutions (soda-water, Seltzer, &c.) give off their gas to nuclei, by virtue of the air that these latter introduce into the solution; in other words, gas must escape into air, and the function of the nucleus is to carry down air: hence, rough bodies act better as nuclei than smooth ones. I have shown,† in a series of twelve experiments, that air is not a nucleus, and that rough bodies are inactive if *catharised* or made chemically clean. A rat's-tail file, for example, is a good nucleus, because it holds between its teeth that filmy kind of matter that is powerfully nuclear; and it is not easy to clean a body of this kind; but, when clean, it is quite inactive. So, a flint stone that has been exposed to the air, or handled, acts as a powerful nucleus; but, when broken, the newly-fractured surfaces are inactive, because chemically clean. And such surfaces are inactive because the gaseous solution adheres to them as a whole; whereas, if a clean body be handled, or exposed to the air, it becomes covered, more or less, with filmy matter, to which the gas adheres more strongly than the liquid, and hence there is a separation of gas.

There is, I think, abundant proof that air is not a nucleus; its function, if it have any, as regards the phenomena in question, being that of a carrier of nuclei. Proof, also, is wanting, I imagine, that, when a nucleus determines the crystallisation of a supersaturated saline solution, a salt of its own kind is present. When M. Gernez so laboriously prepared his nuclei, so as to free them from salt, he did not, perhaps, reflect that he was making them chemically clean. Of course, I fully admit that a salt of the same kind as the solution acts as a powerful nucleus; but, in order for it so to act, it must adhere more strongly to the saline than to the liquid portion of the solution. It may even happen that a crystal of the same kind, and of the fully hydrated salt, has no nuclear action, because it is in a perfectly catharised condition. And here I must refer to the objection raised by Dr. De Coppet, that, in one of my forms of showing the experiment, the hydrated crystals, say, of magnesian sulphate, being introduced into the neck of the flask while the solution was boiling, and so left in the covered flask while the solution cooled, such crystals became so changed by the heat as no longer to represent the normal salt; so that, when lowered into the solution, they formed a different salt, and, hence, were no test of the point in question, as to whether a salt of the same kind may be rendered inactive as a nucleus. I admit the criticism to be just, but, in my original account of the experiment,‡ I

\* *Proc. Roy. Soc.*, No. 108, 1869.

† *Phil. Mag.*, Aug. and Sept., 1867. *CHEMICAL NEWS*, vol. xvi., pp. 54, 149.

‡ *Phil. Trans.*, 1868, p. 665. *CHEMICAL NEWS*, vol. xviii., p. 110.



did not rely upon one form. Highly-supersaturated solutions in clean tubes, plugged with cotton wool, were placed, when cold, over sulphuric acid, under the receiver of the air-pump, and left for some time *in vacuo*; when crystalline crusts of the normal salt formed on the surface, and these, by shaking, fell through the solutions without acting as nuclei; whereas, on removing the cotton wool in the presence of air, the solutions crystallised immediately into a solid mass. So, also, by keeping supersaturated solutions during some months, vapour of water escapes through the cotton wool, and a crystalline crust of the normal salt creeps up the air-filled portion of the tube; and this has no nuclear character, because the adhesion between it and the solution is perfect.

So necessary is the action of a nucleus in determining crystallisation in these solutions, that, if care be taken to exclude nuclei, highly-supersaturated saline solutions may, by reduction of temperature to  $0^{\circ}$  F., or from that to  $-10^{\circ}$  F., be made solid; and, on placing the tubes in snow and water at  $32^{\circ}$ , the solids rapidly melt into clear bright solutions, without any separation of salt. These effects may be shown any number of times; but, whether the solution be solid or liquid, if the cotton wool be removed for a few seconds, crystallisation always sets in, in the case of the solid, during the melting; in that of the liquid, the effect is immediate.

With respect to the editorial note that the solutions of hydrated salts contain the anhydrous salt, I have shown, in my paper in the *Transactions*, and with still greater elaboration elsewhere\*, that such is the case with respect to sodic sulphate. I insist on this point, as it is one of first-rate importance in considering the theory of supersaturated saline solutions. I endeavour to prove that it is the anhydrous salt in solution, by showing that, at various points of the scale, a sudden lowering of the temperature produces a shower of the well-known octahedral crystals of the anhydrous salt. I also explain, in my original memoir, that it is necessary for these crystals to be deposited before the modified seven-atom salt can be formed; and that, even when there is a copious deposit of this salt, the liquor above it is not, as Löwel supposed, the mother liquor of the seven-atom salt, but it is still a solution of the anhydrous salt. And, more than this, when the sudden change in the curve of solubility takes place at  $33^{\circ}$  or  $34^{\circ}$  C., and there is, according to Gay Lussac's supposition, a change in molecular condition, it is still the anhydrous salt that is in solution.

CHARLES TOMLINSON.

Highgate, N., August 8th, 1870.

## EXAMPLES FOR PRACTICE IN QUANTITATIVE CHEMICAL ANALYSIS.†

By FRANK H. STORER,

Professor in Massachusetts Institute of Technology.

SEVERAL teachers who have attended the free courses of instruction in General Chemistry and Qualitative Analysis, established at the Institute of Technology, through the liberality of the trustee of the Lowell Institute, have expressed a desire to prosecute the study of Quantitative Analysis also,—at least, far enough to obtain a general idea of the methods actually employed in that branch of chemical art.

The object of the following communication is to show how readily this desire may be gratified, even without access to a well-appointed laboratory.

In most manuals of Quantitative Analysis, and in most of the laboratories established for teaching students who are to pursue chemistry as a profession, the subject is treated of in such manner that a costly balance seems to be absolutely essential for the conduct of accurate opera-

tions. The would-be amateur is usually disheartened at the first glance by this requirement, and led to regard the study as something not only occult in itself, but impracticable for him, because expensive.

It must be remembered, however, that, though now indispensable to the professed chemist, the delicate "chemical balance" is, comparatively speaking, a thing of yesterday. The science has actually been built up, for the most part, through the use of far rougher implements, such as may now be obtained almost anywhere for a few dollars. There is, in fact, no real difficulty in making thoroughly satisfactory analyses of a great variety of substances, by means of a cheap balance, if the operator will but work with tolerably large quantities of his materials.

The advantage in using a delicate balance consists chiefly in the time gained by operating upon small quantities. Other things being equal, a precipitate, which weighs only a few grains, may evidently be collected, filtered, and washed more readily than one weighing the same number of drachms.

The following analysis made under my direction, in the Institute's laboratory, by my assistant, Mr. A. H. Pearson, may serve as examples of what can readily be accomplished by a careful manipulator tolerably familiar with chemical principles. It may be remarked that several of these analyses are better than the average of analyses made with fine balances and small quantities.

The apparatus required for the following experiments consists of a couple of sheets of "Swedish," and five or six sheets of ordinary filter paper; two glass stirring rods; two glass funnels, each large enough to carry a six-inch filter; three or four glass beakers; a couple of glass flasks, one of them fitted with tubes as a wash-bottle; a crucible and an evaporating dish of Berlin porcelain; a Bunsen's gas-burner, or an alcohol lamp; and an iron ring stand, furnished with a rough sheet-iron saucer,—for use as a sand bath; a triangle of iron wire and a piece of wire-gauze four or five inches square. Instead of the ring stand, a tripod of stiff wire may be used. For experiment No. VI. a burette will be needed also.

The balance actually used in the experiments here recorded was an apothecary's "prescription scale," capable of carrying 60 grammes or more on each pan, and delicate enough to move distinctly with a weight of two milligrammes. It was made by Becker and Sons, of 18, Exchange Place, New York, and bought of their Boston agents, J. T. Brown and Co., corner of Washington and Bedford Streets, for 8.60 dollars in gold. The weights employed were a set of ordinary German gramme weights, worth five or six dollars.

With the exception of parts of Experiments VII. and VIII., all the operations described may be performed without trouble in any ordinary room. The evaporation of the acid liquor in Experiment VII. may be readily effected by placing the lamp, ring-stand, and evaporating dish in a not too tight wooden box out of doors.

### EXPERIMENT I.—Determination of Iron by Precipitation as Sesquioxide.

Weigh out about 3 grammes of fine, tough iron-wire. Put the wire in a beaker of about a litre capacity, and pour upon it 30 or 40 c.c. of pure strong chlorhydric acid. Place the beaker on a sand-bath or piece of wire gauze above the lamp, cover it with a piece of window glass, and heat its contents gently, so that the iron may dissolve with tolerable rapidity, but without violent ebullition. When the iron has dissolved, add 10 or 12 c.c. of strong nitric acid to the solution and continue to heat the mixture. Through the oxidising power of nitric acid, the ferrous chloride will be changed to ferric chloride. Meanwhile, the liquid will become temporarily dark coloured by dissolving a quantity of the hyponitric acid, which results from the reduction of the nitric acid. But after a few moments the liquor becomes clear again, as the nitrous fumes escape, and then exhibits the characteristic

\* CHEMICAL NEWS, vol. xx., p. 277.

† Communicated by the Author. From the *Massachusetts Teacher*.



reddish-brown colour of ferric chloride. As soon as the temporary dark colour has disappeared from the solution, lift the cover of the beaker, and by means of a wash-bottle rinse back into the iron solution any particles of liquid which may have been thrown up during the action of the acid and left adhering to the plate. Dilute the iron solution with pure water enough to nearly fill the beaker, stir the mixture with a glass rod, and transfer half of it to another beaker of the same size as the first. Heat the contents of each beaker almost to boiling, stir the liquor, and add to it, little by little, ammonia water, until the odour of the ammonia persists. A couple of filters of "Swedish paper," each of six inches diameter, will be sufficient to collect the whole of the hydrated sesquioxide of iron thus thrown down. To facilitate the process of filtering and washing, proceed as follows:—Let the contents of each beaker stand at rest for a few moments in order that the hydrate of iron may settle; then pour into the filter the tolerably clear liquid which floats above the precipitate, and pour a quantity of boiling water upon the precipitate in the beaker. As soon as the mixture of precipitate and water has settled again somewhat, pour the tolerably clear supernatant water into the filter and again pour hot water upon the precipitate in the beaker. Repeat this process of *washing by decantation*, some eight or ten times; then wash out the whole of the precipitate from the beaker into the filter, by means of a wash-bottle, and continue to pour hot water upon the contents of the filter, until the last traces of chloride of ammonium have been removed. When the last drops of wash-water have drained away, cover the funnels with paper to protect the precipitates from dust, and set them aside in a moderately warm place.

Transfer the dried precipitate from the filters to a porcelain crucible of known weight, burn the filters upon the cover of the crucible until the last portions of carbon are destroyed, add the ashes to the precipitate in the crucible, cover the latter, and heat it strongly for eight or ten minutes over a Bunsen lamp. In burning the filters, it is well, towards the close, to press down the unburned carbon against the hot porcelain by means of a stiff wire.

After the crucible has been allowed to become cold, weigh it with its contents. This weight, minus the original weight of the crucible and that of the filter ash (for which an allowance of 0.3 per cent of the weight of the paper may be made), will give the weight of the sesquioxide of iron, whence the weight of iron may be calculated by the following proportion:—

Wt. of a molecule of $\text{Fe}_2\text{O}_3$	:	Wt. of the 2 atoms of Fe therein contained	:	Wt. of $\text{Fe}_2\text{O}_3$ found.	:	X.
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Starting with 3 grammes of metallic iron, Mr. Pearson obtained 4.282 grms. of  $\text{Fe}_2\text{O}_3$  ( $=2.9974$  grms. Fe), or in terms of per cents,  $3 : 2.9974 = 100 : 99.91$  per cent.

(To be continued).

### ON GLAUKOPYRITE, A NEW MINERAL.

THE following abstract of a publication by F. Sandberger is taken from *Verhandlungen der K. K. Geologischen Reichsanstalt*:—

In pieces of coarsely-lamellar calc-spar, brought by Dr. Schierenberg from the mines of Guadalcanal, Andalusia, different ores were observed, the examination of which was undertaken by Professor Sandberger. This resulted in the proof of the existence of a new mineral, which occurred, together with solid, crystallised fahlore, proustite, and scattered bunches of Jamesonite, the new mineral greatly predominating in quantity. It appears in kidney-shaped aggregations, composed of extremely thin shells of finely-granular structure, which repeatedly alternate with thin

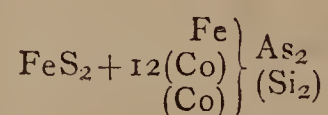
layers of calc-spar, and rarely with those of proustite. The kidney-shaped masses are entirely surrounded with lamellar calc-spar; and, if this is removed with acetic or dilute muriatic acid, the surface appears to be formed by numerous, mostly very small, crystals, in comb-like aggregations. On the layer of these crystals, Sandberger could discern, with a magnifying glass, as a fundamental type, twins of two flat rhombic tables, lying crosswise to each other, and presenting the habitus of cerussite—twins of similar combination; besides these, triplets can be distinctly recognised. The streak of the fine granular masses is shining, but the lustre of the crystal faces is feeble, except certain faces, supposed to be normal prismatic and brachy diagonal prismatic, which have a strong metallic lustre. The colour of the mineral is light lead-grey to tin-white, the streak greyish black; hardness, 4.5; sp. gr., 7.181. In contact with the air, the mineral tarnishes slowly, first assuming a blackish, afterwards a yellowish brown, and finally a blue colour. An analysis made by R. Senfter, in the laboratory of Dr. Petersen, gave the following result:—

Sulphur ..	..	..	..	..	..	2.36
Arsenic ..	..	..	..	..	..	66.90
Antimony ..	..	..	..	..	..	3.59
Iron ..	..	..	..	..	..	21.38
Cobalt ..	..	..	..	..	..	4.67
Copper ..	..	..	..	..	..	1.14

100.04

The new ore belongs, consequently, to the group of arsenical pyrites, and comes nearest to the mineral from Wolfach, which Sandberger identified with Briethaupt's geyerite.

But, as neither form nor hardness, nor specific gravity and colour, are the same in both, and as, moreover, the copper observed in the new mineral is wanting in geyerite, Sandberger proposes, for this new ore from Guadalcanal, the name *glaukopyrite*, and gives for its composition the formula—



—*American Engineering and Mining Journal*.

### NUCLEI AND SUPERSATURATED SALINE SOLUTIONS.

By ARCHIBALD LIVERSIDGE,  
Associate of the Royal School of Mines.

I FORWARD the following account of some experiments made upon supersaturated solutions of sodic sulphate, (and attempted explanations of the action of nuclei upon the same, which have presented themselves to my mind from time to time), in the hope that they may not be entirely devoid of interest to some of your readers.

I may state in the outset, that the experiments were carried out in April, May, and June, 1869, since which date I have repeated and confirmed them all, in some cases, perhaps, a score or more times.

Mr. Tomlinson has already shown that air itself is not a nucleus, nor is a clean crystal of sodic sulphate; he has also shown that a "chemically unclean" rod, or other solid body, may be rendered clean by heating it in the flame of a spirit lamp, or by boiling it in the solution itself. He has also given us a definition of a nucleus:—"A nucleus is a body that has a stronger adhesion for the salt than for the water which holds the salt in solution, a state of things brought about by the absence of chemical purity" (see *CHEMICAL NEWS*, vol. xviii., p. 3); and in vol. xiv., p. 128, he says "this action of solid bodies is due to the greasy film which, after exposure to the air, they are sure to acquire."



My own views regarding the action of nuclei were just the reverse of that given in the above definition. I imagined that the nucleus was a body which had a greater attraction for the water of the solution than for the salt in solution, and I see no reason why this should not be so.

In order to prove, if possible, the correctness of this speculation regarding the nature of nuclei, the following experiments with various dehydrating substances were made:—

*Expt. 1.*—Placed some calcic chloride in a thin glass bulb, fused the chloride within the bulb, then sealed up the tail, and cleaned the exterior of the bulb by holding it by a pair of forceps in a spirit lamp flame; then dropped it into a flask containing the supersaturated solution. No effect was produced, thus showing that no nuclei were carried in by it; the bulb was then broken by means of a clean glass rod. The solution now had free access to the calcic chloride, but no effect was produced, the solution still remaining liquid.

*Expt. 2.*—Quick-lime was heated to redness in a bulb, and the experiment conducted as last. No effect.

*Expt. 3.*—Crystals of chromic acid were likewise tried. No effect.

*Expt. 4.*—Phosphoric anhydride was also employed, but still without determining the crystallisation of the salt.

cork bearing the bulb of alcohol, or acid substituted for it; now, by loosening the glass rod stopper, the liquid under trial was run in. In the case of sulphuric acid, the smaller the drop the better, so as not to raise the temperature of the salt solution. But, as was anticipated from the previous results with calcic chloride, &c., no effect was produced.

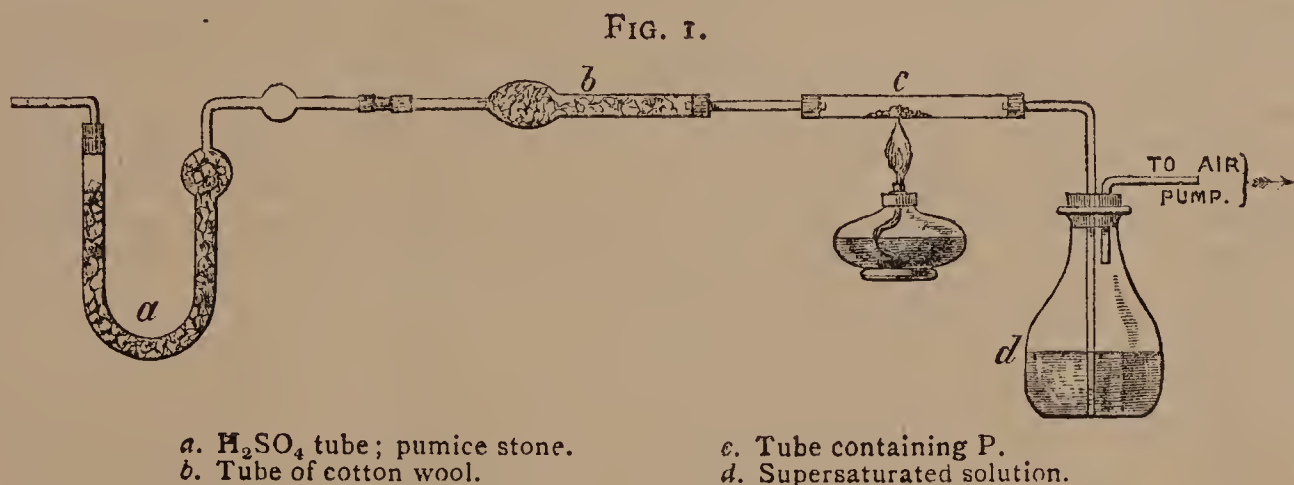
These experiments seem to prove that nuclei do not act by *chemically* abstracting a portion of the water.

Throughout, in each and every case where the substance under experiment did not act, the solution was proved to be in good condition, by dropping into it a dirty crystal or rod.

It next occurred to me, that perhaps the substances under trial acted as nuclei in virtue of their power of abstracting water *mechanically*, absorbing the water within their pores, and rejecting the salt.

At first, this conclusion seemed to be borne out by experiment; for, on dropping into a supersaturated solution pieces of cork, paper, wood, charcoal, cotton, silk, wool, sponge, bone-earth (fragment of a cupel), burnt clay, sulphur, &c., crystallisation was immediately set up.

And I found that if I previously soaked them in water for a few minutes, no matter how dirty and greasy they might be, they now no longer behaved as nuclei; and, to render them as dirty as possible, I rubbed them over with



a.  $\text{H}_2\text{SO}_4$  tube; pumice stone.  
b. Tube of cotton wool.

c. Tube containing P.  
d. Supersaturated solution.

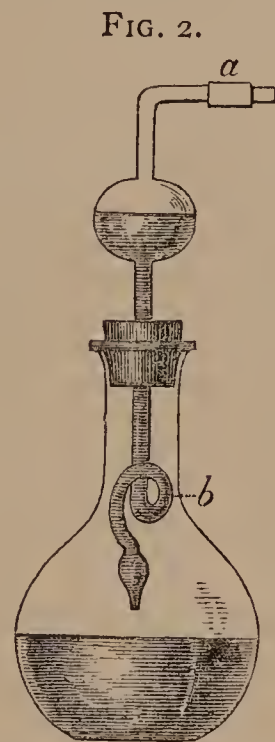


FIG. 2.

*Expt. 5.*—The apparatus as sketched (Fig. 1) was then set up.

While the solution was still hot, air was drawn through the apparatus for some little time, so as to effect the removal of nuclei from the apparatus itself. On the solution becoming cold, air was again caused to pass through, to ascertain the efficiency of the cotton wool and sulphuric acid tubes as filters; they answered perfectly, for no nuclei gained access to the solution. Now the phosphorus was ignited, and a gentle current of air drawn through, carrying with it the phosphoric anhydride thus formed; but, as in the case of the experiments with bulbs, the anhydride had no effect upon the solution. On removing the filter of cotton wool, and again exhausting (as was to be expected), solidification immediately took place.

Several trials were then made with absolute alcohol and concentrated sulphuric acid; the contrivance sketched in Fig. 2 was used (this kind of bulb is largely used at the Royal College of Chemistry for a carbonic anhydride estimation apparatus).

It consists of a bulb tube, *a*, having a knot tied at the end, *b*; this, in conjunction with a stopper, made of a piece of india-rubber tubing and glass rod, enables you to completely control the delivery of the fluid.

The solution was allowed to cool in the flask closed by a plug of cotton wool; this plug was then removed, and the

grease, then rolled them on the dusty carpet; in fact, made them as filthy as possible, but still, on saturating them with water (which was used cold, and very dirty), they were rendered inactive as nuclei.

When, instead of moistening them, I placed them in the spirit-lamp flame and scorched them, their power of setting up crystallisation was also effectually destroyed.

Again, it was found that portions of wood, cork, charcoal, sulphur, &c., taken from the interior of a mass, were perfectly inactive, thus showing that the property was not inherent in the bodies themselves.

When it is found that, by simply placing a greasy rod, pellet of wool, &c., into water for a short time, they are rendered inactive, we cannot attribute their activity, before moistening, solely to the repellent action of the film of grease, for they are just as greasy, after this treatment with water, as before; if it were due to the grease, then their behaviour, before and after immersion, would be the same.

In order to ascertain what effect grease had upon a supersaturated solution the following experiments were made:—

*Expt.*—A glass rod was first cleaned in the spirit lamp, and then dipped into a bottle of hair-oil, and thence transferred to the flask. No effect; inactive.

*Expt.*—Wax was melted on a rod.\* No effect; the flame cleaning both the rod and the wax.

\* Since writing the above, a letter from Mr. J. G. Grenfell has appeared in *Nature* for August 4, 1870, upon the same subject.—A. L.



*Expt.*—Wax, taken from the middle of a lump. No effect; inactive.

*Expt.*—Dirty wax, which previously behaved as a nucleus, after standing in water for some time was thus rendered inactive.

An active rod is not rendered inactive by soaking in methylated spirit, hair-oil, nor benzol, although themselves inactive. But sulphuric acid, hydrochloric acid, solution of ammonia, and aqueous solutions of various salts, do render such a rod inactive. The sulphuric acid may act by destroying the nuclei, while the others may furnish water to them, and so prevent them from acquiring it at the expense of the solution.

All that grease seems to do is simply to facilitate the collection of nuclei; a spot of grease on cloth is always shown up by its acquiring a different colour, due to the adhesion of dust.

From the foregoing, it appears that the substances upon which I have experimented do not themselves behave as nuclei (although other bodies, yet to be tried, must), but that, by exposure to the air, and contact with dusty objects, this property of determining the crystallisation of solutions is imparted to them.

It is highly probable that nuclei may be found to consist of minute organisms and germs floating about in the air, the activity of which is destroyed by heat and by moisture.

I have only been able to make two experiments with microscopic organisms, and they, of extremely little value.

*Expt.*—Dry lycopodium spores; these behaved as nuclei, or contained something else which did.

*Expt.*—Wet lycopodium; inactive.

*Expt.*—Water, containing infusoria, such as *Amæba*, *Vorticellæ*, *Paramæcie*, &c.; inactive.

I may, perhaps, repeat, without attaching too great a value to the results furnished by the above experiments—(1) That it is not impossible that nuclei consist of microscopic organisms, which act by abstracting water, the action being set up at a point from which it is propagated throughout the mass; (2) that they are rendered inactive by heat, because it entirely destroys them; (3) that their action is arrested by previous saturation in water, because they then can no longer abstract water from a saline solution.

Shortly, I hope to have the results of some further experiments.

London, July 12th, 1870.

## ON THE ANILINE OR COAL-TAR COLOURS.\*

By W. H. PERKIN, F.R.S.

(Continued from p. 82).

BEFORE making any further remarks upon the coal-tar colours, I wish to draw your attention to some of their applications to the arts.

I have told you that most of the coal-tar colours contain carbon, hydrogen, and nitrogen, and that they are generally organic bases. They differ essentially from most of the vegetable colouring matters, which contain, with but few exceptions, only carbon, hydrogen, and oxygen, and are weak acids. You will thus understand that many difficulties had to be encountered in their application for dyeing and printing, because they would not combine with the ordinary mordants used for the colouring matters of woods, as alumina and oxide of tin. These observations refer to the dyeing and printing of vegetable fibres, and not to silk or wool, as these materials absorb the coal-tar colours without the intervention of a mordant.

In silk dyeing, the principal difficulty experienced in applying the coal-tar colours was owing to their great

affinity for the fibre, thus preventing the dyer from obtaining an even colour, especially when dyeing light shades.

After a time, however, it was found that this obstacle could be overcome by dyeing the silk in a weak soap lather, to which the colour had been added. This not only caused the dyeing to proceed with less rapidity, but also kept the face of the silk in good condition. Silk dyed by this process is left soft, but may afterwards be rendered hard or "scroop" by rinsing in a bath of slightly acidulated water.

This process was first used for dyeing silk with the mauve or aniline purple. It has, however, been since found suitable for nearly all the aniline colours, as magenta, Hofmann, and Britannia violets, &c. For dyeing silk with coal-tar colours of an acid nature, such as picric acid, dinitronaphthol, &c., the silk is simply worked in a cold aqueous solution of the colouring matter, sometimes slightly acidulated, as when using the sulphoacids of aniline blue or soluble blue. The process of printing silk with aniline colours is comparatively simple. An aqueous or alcoholic solution of the colouring matter is thickened with gum senegal, printed on with blocks, and, when dry, exposed to the action of steam for about half an hour. The gum is then washed off, and the goods finished.

In my last lecture I referred to the formation of two colourless products from magenta, the one called leucaniline, and the other hydrocyanrosaniline.

Some few years since, it was found that if silk dyed with magenta has the reagents necessary for the formation of these colourless products printed upon it, what is called a discharge style can be produced. One of the substances used for effecting this change is powdered zinc mixed with gum. This process also applies to all the coloured derivatives of magenta, and yields better results than can be obtained by printing on the colouring matter and leaving the white parts, because the colours are always clearer when dyed than when printed. But this is not all. When printing two colours on silk, say a pattern with a green ground and purple spots, two blocks have to be used, the one for the ground and the other for the spots; and, when removing the first block, the silk often moves slightly; therefore when the spots are put in by the second block, they do not exactly register, and thus an imperfect result is obtained. This difficulty, however, can be avoided by taking silk dyed with any of the derivatives of magenta, and printing it with the discharge previously mixed with the colour it is desired to introduce, of course employing a colouring matter which is not affected by the discharge, as aniline purple, aniline pink, &c. This discharge style has only been employed for silk at present.

We will now turn our attention to the methods of dyeing wool. These methods, as a rule, are very simple, the wool being merely worked in a hot aqueous solution of the desired colouring matter, no mordant being required. Acids are generally found to be injurious, a neutral bath being preferred, and the operation finished by bringing the temperature nearly up to that of boiling water.

With the blue known as Nicholson's blue, the process of dyeing is different to that just given, and consists of two distinct operations, the wool being first worked in an alkaline solution of the colour, which gives it a kind of grey or slate shade, and then in an acid bath, which develops the colour.

The printing of wool is similar to that of silk, the colouring matter being simply thickened with gum, printed on the goods, steamed, and then washed.

The dyeing of cotton with aniline purple at first presented many difficulties. This colouring matter was found to be capable of producing a very beautiful colour without a mordant, and it was proposed to employ it in this manner, but the colour thus obtained would not bear washing, being nearly all removed with hot water and soap. Mordants, such as alum, were then experimented with, but these gave no results. After some time Mr. R. Pullar and myself found a method of applying this colouring

\* The Cantor lectures, delivered before the Society of Arts.



matter to cotton, which is based upon the insolubility of the compounds it forms with tannin. In using this process the cotton is first soaked in a decoction of sumac or some other tannin agent, then in a solution of stannate of soda, and, lastly, in water, slightly acidulated with sulphuric acid. The cotton thus prepared contains an insoluble compound of tin and tannin, and which possesses a great affinity for aniline purple. The stannate of soda may be replaced by alum, or a solution of tin salt. This method of preparing cotton has been found suitable for nearly all the aniline colours discovered since the mauve, and is now almost universally employed in Great Britain for cotton dyeing. Other processes have been proposed for cotton dyeing, but are not so generally employed as the one just described.

We now pass on to the application of coal-tar colours to the art of calico printing. The mauve, when first introduced, was applied to printing in a very simple manner; the colouring matter was merely mixed with gum and albumen, printed on the goods and steamed; by this process the albumen became insoluble, and fixed the colour. Caseine and gluten were sometimes used as substitutes for albumen. Being dissatisfied with this mechanical mode of applying aniline purple, in conjunction with Mr. Grey, I made a number of experiments with a view of obtaining some more chemical method of fixing this colouring matter, and at last succeeded. The process proposed consisted in printing the pattern with a salt of lead, then converting this into the oxide or a basic salt, by passing the goods through an alkaline solution. Thus prepared, they were worked in a boiling solution of aniline purple in soap. In this way a very pure colour was obtained on the mordanted parts, the soap keeping the whites pure. This process, however, was of very limited application, as it could only be applied for single-colour patterns. After this, several processes were patented for the use of tannin for fixing the mauve; these were based upon the method of dyeing cotton previously mentioned, and some very fast results were obtained, but as these methods are now out of use, I will not describe them further.

The process now nearly universally employed in the north was discovered by M. Alexander Schultz and myself; it consists in printing the colouring matter with a mordant composed of a solution of arsenite of alumina in acetate of alumina. On steaming the cloth printed with this mixture for about half-an-hour, the colour is firmly fixed in the fibre. After steaming, the goods are generally soaped, and then finished. One of the great advantages of this process is that it can be worked in patterns with a great variety of colours, and is also suitable to nearly all the aniline colours, as well as the mauve, yielding shades of great brilliancy.

During the last few years, much attention has been given to the application of aniline black to calico printing. This substance is not prepared in the separate condition, but formed on the fabric; it is produced by printing a mixture of a salt of aniline, chlorate of potassium, and sulphide of copper, thickened with starch, upon the goods, and in this manner a dull grey impression is obtained; but, after three or four days ageing, this changes to a dark olive, and is then rendered perfectly black by passing the goods through a dilute solution of carbonate of soda. This colour is very fast, but is inclined to acquire a slightly green shade by long exposure to the air. Unfortunately, it cannot be printed on with other colours, because, when steamed, the cotton is destroyed by the acid character of the mixture employed for its formation. It can, however, be printed on at the same time as madder mordants, and these can be afterwards dyed with a lead mordant, so that when passed through bichromate of potassium, a pattern with black and yellow or orange can be obtained.

The aniline colours have produced quite a revolution in the arts of dyeing and printing, and have made these processes far simpler than they were, and there is such a

variety of shades of colour now sent into the market, that the dyer or printer has little else to consider than the intensity of the colour required; and, in fact, if a dyer has a large order to execute of a particular shade of colour not in the market, he will not trouble about matching it himself, but sends to the colour manufacturer to supply him with a product capable of yielding the required shade.

Besides dyeing and calico-printing, several other branches have benefited by the coal-tar colours, such as the arts of lithography, type-printing, paper-staining, and colouring, &c. Before they could, however, be used for these various purposes, it was necessary that they should be made into lakes or pigments, by union with alumina or other suitable base; but, as most of the aniline colours are of a basic nature, it was found impossible to combine them directly with a metallic oxide like alumina; advantage was, therefore, taken of their affinity for starch granules, and some very brilliant products were obtained by dyeing powdered starch with the cold aqueous solution of these colouring matters. These starch powders, however, are wanting in covering power or body, so that other processes had to be sought for, and now these lakes are made upon an alumina base, by the intervention of tannin or benzoic acid.

Many attempts have been made to prepare a pigment from rosolic acid or aurine, and this, to some extent, has been accomplished by precipitating a solution of the colouring matter with alumina; by this process, a bright orange-scarlet coloured product can be obtained; it is, however, only suitable for paper-staining. I have, therefore, lately been further experimenting in this direction, and have succeeded in forming a very brilliant scarlet pigment, which can be used for printing inks and a variety of other purposes.

Upon the table there are some specimens of magenta, Britannia violet, aniline blue, green and orange lakes, and also some very beautiful and intense-coloured preparations of coal-tar colours, now generally called carmines. These lakes, when ground with printers' varnish, produce printing inks of very great brilliancy, and are extensively used for this purpose; and Mr. Hanhart, whose name is so intimately connected with the art of lithography, has most kindly furnished me with the various illustrations of the application of these products to lithographic printing for this lecture.

These lakes, in a wet condition, are being largely used for paper-staining, and also for paper-colouring, as well as for a variety of other less important purposes.

The peculiar bronze surface produced by evaporating a solution of an aniline colour, has been taken advantage of by the manufacturer; and all the bronze bonnets, hats, flowers, and feathers, so much worn in the autumn of last year, derived their lustre from aniline colours. When first employed for this purpose, no fixing agent was used with them; and, as they are mostly soluble in water, a shower of rain was often found to cause beautiful purple drops to fall from these bronzed bonnets and hats, and produce a kind of mottled pattern upon the white collars, and sometimes even upon the face of the wearer.

Aniline colours are used for writing inks, colouring soap, &c.; but, as these applications are only of small importance, in a commercial point of view, I will not spend time in speaking about them.

(To be continued.)

## MISCELLANEOUS.

London Institution.—On the 10th inst., Dr. J. P. Gassiot, F.R.S., one of the Vice-Presidents of this Institution, distributed the prizes awarded, and certificates granted, to students who passed the examinations in Physics, Chemistry, and Botany, based upon the courses of Educational Lectures delivered, during the past session, by Professors Guthrie, Bloxam, and Bentley. First-class



prizes were obtained by Edmund Strode, A. J. Richardson, and Emma Ball; second-class prizes by T. Lyon, Esther Greatbatch, Annie Piper, Isidore Harris, E. M. Hutton, A. J. Wallis, and Ellen Benham. Dr. Gassiot stated that Professor Odling had consented to open the coming session with a course of Educational Lectures, "On Chemical Action," and that after Christmas Professor Huxley would deliver a course, "On the First Principles of Biology."

**Utilising a Burning Coal-Mine.**—In the environs of Dudley there was formerly a coal-mine on fire. The snow melted in the gardens as soon as it touched the ground. The gardeners gathered three crops a year; even tropical plants were cultivated; and, as in the Isle of Calypso, an eternal spring prevailed. In another Staffordshire colliery, the firing of which dates many years back, and which is called by the inhabitants "Burning Hill," it was noticed, as at Dudley, that the snow melted on reaching the ground, and that the grass in the meadows was always green. The people of the country conceived the idea of establishing a school of horticulture on the spot. They imported colonial plants at a heavy expense, and cultivated them in this kind of open-air conservatory. One fine day the fire went out, the soil gradually resumed its usual temperature, the tropical plants died, and the school of horticulture was under the necessity of transferring their gardens elsewhere.—*Underground Life.*

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

*Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

*Comptes Rendus des Séances de l'Académie des Sciences, August 8<sup>th</sup> 1870.*

This number, an unusually small one, contains the following original papers relating to physico-chemical and collateral sciences:—

**Relation existing between the Specific Heats and the Coefficients of Expansion of any Substance.**—M. Phillips.—An algebraico-physical paper.

**Decimal Division of the Quadrant.**—A. D'Abbadie.—Abstracts of two letters on this subject from MM. Radau and Airy.

**Estimation of the Rapport of the Two Specific Heats of Gases.**—MM. Jamin and Richard.

**Reply to the Papers Published by H. Sainte-Claire Deville on the 18th of July last.**—M. J. Jamin.—Algebraico-physical papers.

**New Experiments on the Armatures and the Fixed Plate of Holtz's Electrical Machine.**—M. Laborde.—The author describes some of the experiments made by him with a Helmholtz machine, made by converting an ordinary electrical machine.

**Lithological Map of the Mouth of the Seine.**—M. Delesse.—This map represents the geological formations met with at the mouth of the river above named, and along a portion of the coast. It appears that the same geological formations which are predominant in the parts of France bordering on the sea, in the vicinity of the mouth of the Seine, extend to a great distance under the sea.

**Researches on the Toxicological Effects of the M'Boundou, or Icaja, a Poison in Use at Gabon.**—MM. Rabuteau and Peyre.—It appears that, at Gabon, a French settlement on the west coast of Africa, there is in use a vegetable poison, locally known as *m'boundou*, or *icaja*. That substance is the root of a plant which is not further specified. The authors have been experimenting with this substance, which, even in very dilute decoctions, is very bitter, and appears to contain one or more alkaloids, since the aqueous decoction is largely precipitated by iodide of potassium, and also by phospho-molybdic acid. The poisonous effects of this substance bear some similarity to the effects of brucia, but the authors state that, under certain conditions, this poison does not hurt men. Some of the lower animals are readily killed by it; a dose of 3 milligrams of the alcoholic extract, placed under the skin of a frog, kills it; and rabbits and dogs are killed by doses of from 15 to 25 centigrams of the same extract introduced into the stomach.

The larger portion of the time this meeting lasted has been devoted to discussion on the *Phylloxera vastatrix*, and the best means of getting rid of them from the vineyards. The President announced that the next meeting would take place on Tuesday, the 16th, instead of on Monday, the 15th of August, in consequence of the last-named day being a high festival day. The election of a new corresponding member for the Natural History Section is postponed for three months.

*Revue Hebdomadaire de Chimie, July 14, 1870.*

**Delaurier's Galvanic Element with only One Liquid.**—The description, elucidated by a cut, of a galvanic cell composed of zinc and carbon placed in a fluid made up of 40 parts of water, 4.5 parts of bichromate of potassa, 9 parts of concentrated sulphuric acid, 4 parts of sulphate of soda, and 4 parts of the double sulphate of potassa and iron. This element produces a very regular current. The zinc need not be amalgamated, and no gas is evolved.

**Galvanometer with Vertical Needle.**—M. Bourbouze.—The author's description of this instrument is illustrated by woodcuts. The chief aim of this contrivance is to render slight deviations of the needle visible to a large number of students at a time.

July 21, 1870.

**Estimation of Nitrates in Potable Waters.**—M. Scheurer-Kestner.—The author has tested a method for this purpose, originally devised by Dr. Goppelsroeder, and executed in the following manner:—To 50 c.c. of the water to be tested for nitrates are added 100 c.c. of concentrated and pure (free from nitrous compounds) sulphuric acid; to this mixture, which becomes very hot, a weak solution of indigo is added from a burette. The fluid becomes yellow, and, at the end of the operation, green-coloured. The author of this paper does not state the means of titrating the indigo solution, so as to render its use a suitable means of quantitative estimation; but he simply states that, after proceeding with the experiment as just mentioned, another experiment is made, wherein, instead of the addition of sulphuric acid to the water, there is added to it the quantity of c.c. of indigo solution first found necessary to produce a reaction.

**Description of an Apparatus for the Continuous Preparation of Carbonic Acid, and of Lime, by One Operation.**—A. Perret.—This paper, accompanied by woodcuts, describes, at length, a contrivance especially suited for beet-root sugar works, to decompose, by the joint agency of red-heat and steam, limestones in such a manner as to make the escaping carbonic acid gas available for use in the beet-root sugar manufacture.

*Les Mondes, July 21, 1870.*

**Higher Public Instruction in France.**—From a circular addressed to the recteurs by the Minister of Public Instruction, it appears that the French Government intends to lay out a large sum of money for improving, repairing, and completing the buildings (inclusive of laboratories, botanical gardens, &c.), museums, and scientific collections, libraries included, and for the expenses of heating and lighting rooms, halls, and other places adapted to the use of the various divisions of the Université de France, and the colleges and schools connected therewith.

**Utilisation of Vine-Leaves and Cuttings of Young Vine-Twigs.**—J. Guyot.—It appears that the materials alluded to are now partly given to the cattle in fresh state, and are partly salted for winter forage. Since France possesses 2,500,000 hectares of vintage-ground, the green materials mentioned will yield, according to the author, a sufficient quantity of food for cattle, at the rate of 20 kilos. per head for at least 100 days.

**Geological Alpine Congress.**—A number of scientific men, inhabitants of the Helvetic Republic, intend to hold, on August 31st and two following days, at Geneva, a meeting, chiefly with the view of starting a well-planned geological study of the larger chain of the Alps by Swiss, French, and Italian geologists. The well-known M. F. J. Piéret is one of the promoters of this meeting.

July 28, 1870.

**Crystallisation of Iron and Steel.**—Dr. Schott.—The author has examined a large number of samples of iron and steel, microscopically, and states that his observations lead him to consider that, the more regular and small the crystals are of which iron and steel are always composed, the better the metal. Moreover, in the good qualities of these substances the crystals are placed very regularly near each other.

**Uniformity of Time for Military Camps.**—Rev. F. Moigno.—The author discusses, but does not exactly describe, an instrument which appears to be of great utility for regulating and adjusting clocks and watches, and which is so portable and readily put together that any soldier may be left in charge of it. The price of this piece of mechanism is only 22 francs annually.

August 4, 1870.

**Hygienic Vinegars.**—A. Servel.—The author purifies wine vinegars, by a series of operations, not specified, so as to render them highly pleasant, strong, agreeably acid liquids, especially adaptable to being mixed with water, and thus rendering it (even when otherwise rather unpleasant) a refreshing, wholesome, and thirst-quenching fluid, highly recommended above the use of spirits in armies and navies,



also on account of the tonic properties the vinegars alluded to appear to possess.

**Economical Candles.**—M. Sokolnicki.—A paper, illustrated by several woodcuts, on the best plan for the manufacture of candles so as to make them give the most and best light and provide for complete combustion of the materials they are made of, with the least possible expenditure at the same time.

**New Electric Battery Invented by M. Chutaux.**—(Reported on by R. Francisque-Michel.)—A lengthy report, illustrated by a series of woodcuts. It appears that the results obtained are—

	Electromotive force.	Internal resistance.
Chutaux battery .. .. .	11'400 .. ..	6'00
Marié-Davy battery .. .. .	8'192 .. ..	5'50
Daniell battery .. .. .	5'973 .. ..	9'31
Peroxide of manganese battery	7'529 .. ..	4'00

*Cosmos*, July 30, 1870.

**Historical Facts about Potatoes.**—Marshal Vaillant.—This well-known vegetable, first imported into Europe from Peru by Francis Drake, remained a very long time almost unknown; it was not cultivated in Germany until after 1710, and then only in gardens. Its introduction into France, from Germany, dates about 1749, and it never was generally introduced in the last-named country until about 1820. In the south of France, potatoes are comparatively rare, and rather an expensive vegetable, as compared with lentils, beans, &c.

**Purification of Dirty Water.**—S. Meunier.—Since, in dry seasons, any water may be of high value, at least for cattle-drinking, the author advises to place, in a large-sized cask, a false bottom perforated with some holes; and to put on that bottom, first, clean pebbles, next, well-washed sand, then a layer of coarsely-granulated charcoal, and over all this a piece of canvass. The water, even that accidentally standing in shallow ditches after a shower of rain, may be poured into this filter, and thus become available for cattle-drinking, though it may not be quite clear.

August 6, 1870.

**Cause of the Fatigue to the Eyes caused by Artificial Light.**—V. Meunier.—The author states that the great difference between sun and artificial light is due to the fact that, of the light emitted from the former, about half the quantity of rays are luminous and calorific at the same time; but, as regards our artificial light, for ordinary oil (colza oil), the amount of non-luminous, yet calorific, rays is 90 per cent; for white-hot platinum, 98 per cent; alcohol flame, 99 per cent; electric light, 80, and gas-light, 90 per cent; while for petroleum and paraffin oils, the amount is 94 per cent. It is this large quantity of calorific rays in artificial light which causes the fatigue to the eyes; but this inconvenience may, according to the author, be almost entirely obviated by intercepting the thermic rays by glass, or, better yet, mica plates. The use of these renders the light soft and agreeable to the eyes.

**Possibility of Obtaining Luminous Signals Visible at Great Distances.**—Dr. Delaurier.—The author proposes the use of galvanic electricity, so applied as to have the effect of producing what, in light-house terminology, is known as "flashing light." The idea of the author is to bring this into practice by means of a peculiar induction apparatus, so contrived as to cause the least possible expenditure of electricity, and to interrupt the current, so that only by the passage of a spark between the carbon-points at intervals of from two to five seconds of time, a luminous flash be produced, visible, even in foggy weather, at a great distance.

**New Use for Hyposulphite of Soda.**—S. Meunier.—The author states that experiments made with this salt have proved it to be very superior for use for washing linen to the carbonate of soda now in use; it has no corrosive action, and does not cause a yellow colouring of the fabrics after some time. Borax, largely used in the Netherlands and Belgium, is a better substitute still, and, by its use, white fabrics assume an agreeable bluish hue, which, in many instances, renders the subsequent use of washing-blue unnecessary.

**A New and Highly-Recommended Book.**—At one of the late meetings of the French Academy, M. Dumas spoke in highly-eulogising and, to the author, complimentary terms, on the work just published by M. Louis Figuier, which bears title, "Armes de Guerre et Bâtiment Cuirassés." In this work, illustrated by 237 engravings, the author gives an accurate description of all the contemporaneous arms of war—various kinds of guns, pistols, &c., mitrailleuses inclusive, and of iron-clad ships, as in use by different nations. The price of this book is 3 francs 50 centimes.

*Monatsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin*, May, 1870.

This number contains the following original papers relating to chemico-physical and collateral sciences:—

**Some New and Remarkable Properties of the Diametral Conductors of the Electro Machine, and Description of a New Kind of Double Machine the Construction of which is Based upon a New Principle.**—Dr. J. C. Poggendorff.—A lengthy memoir, accompanied by engravings.

**Composition of the Meteorites of Shalka and Hainholz.**—Dr. Rammelsberg.—This paper is chiefly written with the view of proving that the assumed existence of a peculiar mineral, which was named shalkite, and obtained from the meteorite of Shalka (Bengal,

where the stone fell on the 30th of November, 1850), is erroneous, inasmuch as the author's analysis of this meteorite proves it to be, mineralogically, a mixture of bronzite, olivine, and chrome-iron ore; while the Hainholz meteorite (the time when this mass fell is uncertain; the stone was found in 1856, near Paderborn, Prussia, by Dr. Mühlendorff) also consists of olivine and bronzite, in addition to meteoric iron. The lengthy memoir contains the results of a series of analyses of the meteorites alluded to, but space forbids us to enter into more details here.

*Journal de Pharmacie et de Chimie*, July, 1870.

This number contains the following original papers and memoirs:—

**Method for Readily Testing the Fatty Oils.**—Dr. Massie.—In order to test the purity of the oils, the author employs nitric acid (sp. gr. of from 1'38 to 1'41) and metallic mercury. Five grms. of this acid, and 10 grms. of the oil to be tested, are mixed together in a test-glass of 100 c.c. capacity, and the mixture stirred for a couple of minutes. The liquid is then left standing; and, when the fluid has separated into two layers, the colour of these layers is noted. This colouration may be from greenish white to deep brown for the superior, or lighter layer; while the colouration of the acid, always less intense, will vary from light yellow to deep yellow, or even rose-red. After a while, 1 grm. of metallic mercury is added, the final result of which addition will be the solidification of the bulk of the oil in most cases. There is added to this paper a lengthy series of description of the phenomena observed when various oils, and mixtures of different oils, are treated by the reagents alluded to; but it does not appear that the ultimate result is such as to definitely and absolutely render it possible to recognise and detect adulterations of oils. The test is only of a relative value.

**Extract from a Report on a New Process of the Quantitative Estimation of Quinine in Barks.**—Dr. Carles.—The editors of this periodical state, in a foot-note, that they will shortly publish the author's memoir in full.

**Chemical and Therapeutical Researches on the Thermo-Mineral Water of the Solfatara at or near Pouzzoles (Herault, France).**—S. de Luca.—One litre of this water contains, in grammes, weight—Sulphuric acid (calculated anhydrous), 1'473; chlorine, 0'0085; protoxide of iron, 0'1105; lime, 0'101; magnesia, 0'0225; potassa, 0'017; ammonia, 0'0135; alumina, 0'335; silica, 0'315; soda, manganese, arsenic, and organic matters, traces; water, 997'603. This water may be industrially applied for the manufacture of alum.

**Test for Detecting the Presence of Guaiacum Resin among the Resin of Jalap.**—Dr. Blacher.—The author puts 50 centigrms. of guaiacum resin, and 20 centigrms. of oxide of copper, in a porcelain mortar, and adds about 20 drops of alcohol. When this mixture is triturated, nothing particular is seen, but, as soon as about 15 drops of ammonia are added, a beautiful apple-green colouration is produced. When this experiment is repeated with resin of jalap, no such green colouration whatever is seen; the mixture remains brown-coloured.

*Bulletin de l'Académie Impériale des Sciences de St. Petersburg*, Vol. xiv., Nos. 5 and 6.

These numbers contain the following papers relating to chemistry and allied sciences:—

**Influence of Heat upon the Elasticity of Caoutchouc.**—J. Schmulewitsch.—An algebraico-physical essay.

**Derivatives of the Isocaprin Series.**—A. Borodin.—This paper treats chiefly, and at great length, on the products of the oxidation of a new monatomic alcohol,  $C_{10}H_{22}O$ . The main product obtained by the author is an aldehyde, a liquid boiling at 147°, and not frozen even at -37°; sp. gr. at 0°, 0'82783; formula,  $C_{10}H_{20}O$ . The author further describes an acid,  $C_{10}H_{20}O_2$ , which combines with bases, forming salts. The acid is a liquid, boiling at 241'5; sp. gr. at 0°, 0'90956; insoluble in water, but soluble, in every proportion, in alcohol and ether.

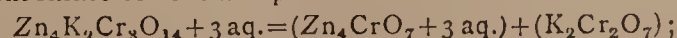
*Annalen der Physik und Chemie*, von Poggendorff, No. 5, 1870.

This number contains the following original papers and memoirs:—

**Influence of the Ponderable Molecules on the Dispersion of Light, and on the Importance of the Constant Dispersion Formulæ.**—E. Ketteler.—The continuation and end of this lengthy memoir.

**Sound Emitted by Heated Tubes, and the Vibrations of Air in Tubes of Various Shapes.**—Dr. C. Sondhauss.

**On Chromates.**—C. Freese.—In this portion of his lengthy essay, the author describes the following salts:—Chromate of copper and potassa,  $Cu_2.K_2Cr_3O_{13}+2aq.$ ; normal chromate of zinc; basic chromate of zinc (containing, in 100 parts— $ZnO$ , 54'12;  $CrO_3$ , 10'81; water, 11'57); chromate of zinc and potassa—



chromate and basic chromate of cadmium; chromate and basic chromate of nickel,  $Ni_2CrO_6+2H_2O+aq.$ ; chromate of cobalt; and chromate of protoxide of manganese.

**Mechanical Force Exerted by Moving Masses of Gas.**—Dr. L. Boltzmann.



Calculation of the Vibrations of a String of a Musical Instrument, as referred to its Resistance to Bending.—R. Hoppe.

Figures Produced by the Action of Acids upon Certain Substances (Etching), and on the Phenomena of Asterism in Crystals.—Dr. H. Baumhauer.—Illustrated by a series of engravings.

Velocity of Molecular Motion and of Sound in Gases.—E. Mulder.

Production of Standing (Stehender) Vibrations and Sound Figures in Elastic and Fluid Liquids by the Aid of Solid-Sounding Plates.—A. Kundt.

Elastic Vibrations.—Dr. J. J. Müller.

Occurrence of Augite in Meteorites.—C. Rammelsberg.—This paper contains the following sections:—Enstatite in meteorites; bronzite in meteorites; augite in meteorites.

The Lodran Meteorite.—G. Tschermak.—The author found this meteorite to consist, in 100 parts, of—Iron, 85.44; nickel, 12.79; magnesia, 0.81. Mineralogically, the stone consists of—Nickeliferous iron, 32.5; olivine, 28.9; bronzite, anorthite, and chromite, 30.2; magnetic pyrites, 7.4 per cent.

Acoustical Attraction and Repulsion.—Dr. Schellbach.

Maximum Degree of Density and the Freezing-Point of Mixtures of Alcohol and Water.—Dr. F. Rossetti.

Best Method for Studying the Nature of Flames.—L. Du-four.—The author describes a contrivance by means of which the well-known use of a wire gauze for examining the nature of flame is replaced by a thin sheet of water.

Colours Exhibited by Iodine.—C. Schultz-Sellack.—This paper treats chiefly on the differences exhibited by the colour of iodine in thin plates, in vapour, and in solution. Iodine is deep brownish red-coloured in thin layers; its vapour is violet; and some of its solutions exhibit the former, some the latter colour.

Platinum in Lapland.—Dr. Nordenskjöld.—It appears that gold having been found some years ago in the neighbourhood of the Ivalo river (Northerly Sweden), a more recent search there has given rise to the discovery also of some platinum, which, according to a brief foot-note added to this paper, has also recently been found near Ibbenbüren, Westphalia.

Confirmative Test of the Genuineness of the Bohemian Diamond from Dlaschkowitz.—A few milligrams of this stone have been burnt in oxygen by Dr. Schafarik, in the presence of MM. Krejci, Rochleder, Waltenhofer, Zenger, and von Zepharovich. The result is that carbonic acid was given off, as proved by the turbidity caused by the products of combustion being led into baryta water, and no residue whatever being left.

*The American Journal of Science and Arts*, July, 1870.

This number contains the following original papers relating to chemistry and collateral sciences:—

Photometric Experiments.—Part II.

Amount of Light Transmitted by Plates of Polished Crown-Glass at a Perpendicular Incidence.—O. N. Rood.

The Ethers of Arsenic and of Arsenious Acid.—J. M. Crafts.—The author describes—Arseniate of ethyl, prepared by the action of the iodide of ethyl on the arseniate of silver. Arseniate of ethyl is a liquid; sp. gr. at 0°, 1.3264; it is a very unstable compound, which attracts moisture from the air, and is immediately decomposed into arsenic acid and alcohol; this body contains 33.18 per cent of arsenic. Arseniate of methyl, a liquid; sp. gr. at 14.5°, 1.5591. Arseniate of amyl. Arseniate of ethyl, also a liquid; sp. gr., 1.224; vapour density, 7.2673; this liquid is miscible with alcohol and ether, but is decomposed by aqueous alcohol. Arseniate of methyl: sp. gr., 1.428; vapour density, 5.818. Arsenite of amyl: sp. gr., 1.0525; this, and all the compounds alluded to, are not at all stable, being readily decomposed by water and moisture.

Notice of some Minerals from New Jersey.—W. T. Roepper.—The author describes, at some length—Chrysolite, a mineral containing chiefly iron, manganese, zinc, and silica, the percentage composition being—Silica, 30.76; protoxide of iron, 33.78; protoxide of manganese, 16.25; oxide of zinc, 10.96; magnesia, 7.60. Magnesian dolomite, composed, in 100 parts, of—Carbonate of lime, 50.40; carbonate of protoxide of manganese, 43.54; carbonate of protoxide of iron, 0.76; carbonate of magnesia, 5.69; insoluble, 0.08.

Miscellaneous Optical Notices.—Dr. Wolcott Gibbs.

Theoretical Temperature of the Sun, under the Hypothesis of a Gaseous Mass Maintaining its Volume by its Internal Heat, and Depending on the Laws of Gases as known to Terrestrial Experiment.—J. Homer Lane.

Mineralogical Contributions.—C. U. Shepard, sen.—The author describes, at length—A new variety of columbite, found to consist, in 100 parts, of—Metallic acids, 78.30; protoxide of iron, 13.86; protoxide of manganese, 7.72; traces of tin. Unknown mineral (microlite?) in Haddam columbite. New locality of bismuthine and bismuthite, in Haddam. Metallic acid in microlite. Redondite, a mineral found in Redonda Island, and containing 44.07 per cent of phosphoric acid, 24.73 per cent of water, and oxide of iron and alumina. Phosphoric acid in the diaspore of Chester, Mass.; the mineral here alluded to is mainly hydrate of alumina, containing only 0.32 per cent of phosphoric acid. The Pelham vermiculite contains, in 100 parts—Alumina, 14.0; magnesia, 13.68; peroxide of iron, 32.0; silica, 24.0.

Hydrogenium-Amalgam.—O. Loew.

*Journal für Praktische Chemie* (double number), Nos. 11 and 12, 1870.

This number contains the following original memoirs:—

Foundation of Chemistry by Lavoisier.—J. Volhard.—This valuable memoir opens, unfortunately, with an attack upon the French as a nation, by stating that they are in the habit of very greatly exaggerating the merits of their great men, and, by so doing, forgetting the real value of their labours. The author's memoir is otherwise an excellent contribution to the early history of chemistry as a science, due stress being laid upon the high value of the labours of Scheele (a Swede), Priestley, Cavendish, Black, Marggraf, Fourcroy, Vauquelin, and others.

Quantitative Estimation and Separation of Cobalt and Nickel.—Dr. E. Fleischer.—To the acid solution of both metals, the author first adds hypochlorite of soda (eau de Javelle) and solution of caustic potassa in excess; the liquid is next heated to the boiling-point; and the ebullition is continued until the precipitate has become quite black. The precipitate is collected on a filter. The mixed sesquioxides are separated from each other by the use of warm liquid ammonia, which dissolves the sesquioxide of nickel, leaving the sesquioxide of cobalt.

Action of Chloride of Chromic Acid upon Aromatic Hydrocarbons.—E. Carstangen.—This lengthy memoir is divided into the following sections:—Introduction; action of chloride of chromic acid upon naphthalene, anthracene, toluol, xylol, mesitylen, diphenyl, phenol, nitrobenzol, aniline.

Crystalline Pigment of Turmeric Root.—Dr. F. W. Daube.—This paper has been already alluded to, having been abstracted from another German periodical (see *CHEMICAL NEWS*, vol. xxii., p. 84); but the paper, as published in the above-named periodical, contains, besides, the following brief notice relating to the essential oil of turmeric root:—Forty pounds of the Bengal root yielded, when treated with steam, 400 grms. (about 2 per cent) of the essential oil, which is to be further investigated by Dr. Claus.

*Revue des Cours Scientifiques de la France et de l'Etranger*, July 23, 1870.

This number does not contain any original papers relating to chemistry or collateral sciences, but we learn that Professor Helmholtz, appointed to succeed the late Professor Magnus, at Berlin, will not leave for that place until the month of April next, it being his desire to stay the winter at Heidelberg.

## NOTES AND QUERIES.

Condensing Hydrochloric Acid Gas.—(Reply to "Salt").—Consult Richardson and Watts's "Chemical Technology," vol. i., part 3.

Brewing Queries.—(Reply to T. Gregson).—Consult "Theory and Practice of Brewing," by W. L. Tizard (London, 1857), which you can inspect at the Library of the Commissioners of Patents.

Estimation of Alkalies in Silicates.—"Analyst" will find a full description of Dr. Lawrence Smith's method of estimating the alkalies in silicates in my "Manual of Chemical Analysis," p. 473. I have been using this method rather extensively lately in the analyses of fire-clays and bricks, and can recommend it as both simple and accurate. I mix 50 grains of the clay or brick with 250 grains of carbonate of calcium and 30 grains of chloride of ammonium, and heat to bright redness in a platinum crucible for half an hour; neither fusion nor a higher temperature than bright redness are necessary. I obtain the carbonate of calcium pure, by precipitating pure chloride of calcium by carbonate of ammonium; neither carbonate of sodium nor carbonate of potassium must be used, it being impossible to free the precipitated carbonate of calcium from either of these alkalies by any amount of washing. To prove this, I may mention that, having found in a sample of carbonate of calcium, which had been precipitated by carbonate of sodium, nearly 1 per cent of carbonate of sodium, I washed it almost uninterruptedly for several days with boiling distilled water, but failed to remove any material quantity of the alkali.—HENRY M. NOAD, St. George's Hospital.

## TO CORRESPONDENTS.

\*\*\* Vol. XXI. of *THE CHEMICAL NEWS*, containing a copious index is now ready, price 11s. 4d., by post, 11s. 10d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our office, or, if accompanied by a cloth case, for 1s. Subscribers wishing to complete their sets of volumes are requested to apply to the publisher, who will give them information respecting scarce numbers and volumes. Vol. xxii. commenced on July 1st, and will be complete in twenty-six numbers.

J. Wallace Young.—"Traité des Matières Colorantes, comprenant leurs Applications à la Teinture et à l'Impression; et des Notices sur les Fibres, Textiles," &c., par P. Schützenberger; 2 vols., 19s. Paris: 1867; V. Masson.

F. W. Thomson.—We believe the work you allude to is out of print.

W. H. Perkin.—Received, with thanks.

F. G. Cooper.—Your request has received attention.

J. S. Sellon.—Received.

J. C. Brough.—Thanks for your communication.



# THE CHEMICAL NEWS.

VOL. XXII. No. 561.

## NUCLEI AND SUPERSATURATED SALINE SOLUTIONS.

By ARCHIBALD LIVERSIDGE,  
Associate of the Royal School of Mines.

PROFESSOR TYNDALL has shown, by means of the beam from an electric lamp, that the minute particles of dust which ever float in the disturbed air, may be effectually arrested by means of a cotton wool filter; he therefore recommends (*Nature*, vol. i., p. 342) the use of cotton wool respirators as a defence against contagion, since they would completely intercept the dirt and germs borne by the atmosphere.

In order to ascertain if there were any real necessity for such respirators—in fact, to prove the filtering power of our natural respirator, the nose—the following experiment was performed:—

*Expt.*—A flask containing a supersaturated solution of sodic sulphate was fitted up as a Woulff's bottle; whilst the solution was cooling the apertures of the two tubes were plugged with cotton wool. When the solution was cold these plugs were withdrawn, and air which had been respired through the nose was forced through the solution.

In some cases the current of air was maintained for ten or fifteen minutes. The solution was kept cold by the immersion of the flask in water, for if the temperature had been allowed to rise by the absorption of heat from the breath the experiment, would, of course, have been vitiated.

No effect was produced, thus showing the perfect efficiency of the hairs and mucous membranes lining the nasal passages in arresting nuclei.

When we inspire through the mouth, the dust of the air has a free and unimpeded course to the lungs, where it settles and clogs up the delicate air passages with putrescent matter. Not only is the air purified by inhaling it through the proper channel, but it is warmed also.\*

In an abstract of one of his papers (*CHEMICAL NEWS*, vol. xix., p. 128) Mr. Tomlinson explained the sense in which he applied the term catharism or "chemical cleanness" in contradistinction to ordinary cleanness, by stating that the finger could not possibly be made clean (*i.e.*, inactive as a nucleus) by any process, whereas a glass rod could be.

Regarding the finger as a greasy rod, I could see no reason why it should not be made inactive in the same way as a glass or other rod.

*Expt.*—Held the finger in water for a minute or so, then transferred it to the supersaturated solution. No effect.

*Expt.*—Passed the finger through a spirit-lamp flame several times, then immersed it in the solution. No effect.

Hence, the finger is readily made to behave as if it were catharised.

In the last number of the *CHEMICAL NEWS* (p. 88), Mr. Tomlinson states that oil and fatty bodies, whether chemically clean or not, do not act when in mass, as globules, &c., but only in thin films.

For my part, I have never found that the quantity or form of the oil, &c., has ever had any effect upon the behaviour of the salt in solution. Many times the oil or fat has been spread over the surface of the solution as a thin film, even thin enough to be iridescent, and the

internal surface of the flask has also been coated in the same way, but this has not determined the solidification of the salt.

Then again, on the same page, he says, oils and fats are chemically clean which are chemically pure. Does not the following refute this statement?

*Expt.*—A mixture of wax, oil, soot, dust from floor, sulphur, sodic sulphate, soap, &c., was melted together on a glass rod and then dipped into the supersaturated solution. No effect.

The oil and fat in this case were certainly not chemically pure; therefore, according to Mr. Tomlinson, they ought not to have been chemically clean, *i.e.* inactive; but they were inactive nevertheless.

Might I suggest that it would, perhaps, be as well to do away with the terms "chemically clean" and "catharism," for if my results be trustworthy—and I have been at much pains to make them so—the conclusion to be derived from them is that there is no connection whatever between the active state of a nucleus and its want of chemical purity; a pure chemical or other pure body is just as quickly rendered active as a nucleus by exposure to the air or by contact with objects which have been so exposed, as is a substance composed of the most heterogeneous mixture imaginable,\* and they may both, with equal facility, be re-converted into the inactive state on exposure to a sufficient heat or to moisture.

Although in my former paper I suggested, and do still, that nuclei may be found to consist of microscopic organisms, I do not quite reject M. Gernez's hypothesis that the nuclei may consist of universally diffused particles of the sodic sulphate, but in what state it exists and exerts its influence has not yet been shown. Mr. Tomlinson has pointed out that it is not in the form of the anhydrous salt, nor is it that with seven atoms of water, since you obtain both these salts nearly every time you prepare a supersaturated solution; and ignited sodic sulphate is certainly not a nucleus. All we can do is to still apply questions and extort an answer from nature.

London, August 19th, 1870.

## ON THE FUNCTIONS OF NUCLEI WITH RESPECT TO SUPERSATURATED SALINE SOLUTIONS.

By CHARLES TOMLINSON, F.R.S.

I TRUST it will not be thought disrespectful to fellow-workers in the same field, if I refer them to my paper on supersaturated solutions, which was read before the Royal Society on the 16th June last, an abstract of which is printed in the *Proceedings*, No. 122, page 533.

I think it will be found that the line of experimental research adopted by Mr. Grenfell, and also by Mr. Liversidge, had been anticipated by me; but it would afford me the highest satisfaction if such able observers would review their work with reference to my latest results.

It will be seen from my note, in answer to Mr. Grenfell, that my definition of *chemically clean* applies to all bodies, including oils and solid fats. If a stick of tallow be chemically clean it will not act as a nucleus, because the solution adheres to it as a whole; but a film of tallow will act powerfully. So, also, a globule of castor oil will not act if chemically clean, but a film of it will act as a nucleus.

If a drop of a liquid be placed on the surface of a supersaturated saline solution, it will (apart from chemical action) do one of three things; (1) it will diffuse through the liquid, and in general not act as a nucleus, as in the case of glycerin; (2) it will spread out into a film; or (3)

\* There is nothing to prevent each of the constituents being itself chemically pure, and if each, when separate, is inactive, why should the mixture not be inactive also?

\* See a letter upon this in *Nature* for Feb. 17, 1870.



remain in a lenticular form. It becomes a film or a lens according to the general proposition, that if on the surface of the liquid A, whose surface tension is  $a$ , we deposit a drop of the liquid B, whose surface tension,  $b$ , is less than  $a$ , the drop will spread into a film; but if, on the contrary,  $b$  be greater than  $a$ , or only a little less, the drop will remain as a lens. The *superficial viscosity* of the solution may in some cases interfere with the rigid application of this proposition.

An active, or non-catharised surface, is one contaminated with a film of foreign matter, the filmy condition appearing to be necessary to secure that close adhesion which brings about the nuclear action.

Some liquids, such as alcohol, form films and act as nuclei by separating water instead of salt from supersaturated solutions.

Fatty oils may saponify, or oil of bitter almonds form benzoic acid, in contact with supersaturated solutions of Glauber's salt without acting as nuclei.

When a drop of a fatty oil spreads out into a film on the surface of a cold supersaturated solution of Glauber's salt, very fine prismatic plates of the ten-atom salt, with dihedral summits, fall from every part of the lower surface of the film; an effect quite different from the crowded diverging mass of crystalline needles which proceeds from a point in the surface when a speck of dust is let in, or the surface is touched at one place.

Liquids such as ether, alcohol, naphtha, benzol, oil of turpentine, cajuput, and other volatile oils; sperm, herring, seal, olive, linseed, castor, and other fixed oils, act powerfully as nuclei when they form films; but when they form lenses there is no separation of salt, even though the flask, being whirled round, so as to break up the lens into small globules. But if, by a sudden jerk, a globule of oil be flattened into a film, the solution immediately becomes solid.

"Stearine from sheep's tallow that had been exposed to the air produced immediate crystallisation; but by boiling the solution, and covering the flasks, the stearine, now catharised, had lost its nuclear character in the cold solution. Similar observations were made with the fixed oils that form lenses or globules in the solution. So also volatile oils, containing products of oxidation, dust, &c., are nuclear, but when catharised, by being re-distilled, they are inactive in the globular state, active in the form of films.

"When a liquid forms a film on the surface of a supersaturated solution, the surface-tension of the solution is so far diminished as to bring the film into contact with the solution, when that differential kind of action takes place, whereby, the salt of the solution adhering more strongly to the film than the water of the solution, the action of separation and crystallisation, thus once begun, is propagated throughout. A similar action takes place with solid bodies that have contracted filmy nuclei, by being touched or drawn through the hand, or merely exposed to the air; they are active or nuclear by virtue of the films of matter which more or less cover them.

"On the other hand, when a drop of oil (or many drops) is placed on the surface of a supersaturated saline solution, and it assumes the lenticular form, or even flattens into a disc, such lens or disc is separated from actual contact with the solution, by surface tension. That the adhesion is very different from that of a film may be shown by pouring a quantity of recently distilled turpentine, for example, on the surface of chemically clean water, and scraping upon it some fragments of camphor; these will be immediately covered with a solution of camphor in the oil, which solution will form iridescent films, and sail about with the camphor, vigorously displacing the turpentine, and cutting it up into smaller discs and lenses. So in the case of supersaturated saline solutions, the oil-lens is not sufficiently in contact with the surface of the solution to allow of the exertion of that differential kind of action whereby salt is separated. Even when by shaking, the oil is broken up into globules,

and these are submerged, they are still so far separated from the solution by surface-tension as to prevent actual contact."\*

It should be remarked that, in experiments on the action of nuclei on supersaturated saline solutions, the flasks must on no account be plugged with cotton wool, because in removing the plug an equal volume of air enters, and is almost certain to carry active nuclei with it. The process adopted by me is to boil a solution of 1, 2, or 3 parts of Glauber's salt to 1 part of water in a large flask, and to filter the boiling solution into 6, 8, or 10 five or six ounce flasks (each flask receiving two or three ounces of the solution), and then, covering each with a watch glass, to leave the flasks until cold, or until the next day. If the solutions had previously been operated on with fixed oils, the flasks, although cleaned for fresh trials, may not be so clean but that strong solutions in cooling crystallise. This may in general be prevented by re-boiling the solution for a few seconds after it has been filtered into the small flasks. In making an experiment, thin fluids, such as ether, benzol, &c., may be taken up in a clean straight dropping tube, fatty oils on a clean glass rod, and the watch glass being gently removed, a drop of the liquid is to be deposited on the surface, the tube or rod to be slowly withdrawn, and the watch glass replaced. In shaking a flask, the watch glass is to be held down firmly with the finger or thumb of the hand that grasps the neck.

Sodic sulphate is the best salt for the class of experiments indicated, but I have obtained good results with supersaturated solutions of potash and of ammonia alum, of sodic acetate, and magnesia sulphate. The films which spread on the solutions of alum produce very fine results of crystallisation.

Highgate, N., August 19th, 1870.

#### PRELIMINARY NOTICE ON THE NITRO-SUBSTITUTION COMPOUNDS OF THE ORCINS.

By J. STENHOUSE, LL.D., F.R.S., &c.

MANY attempts have been made to prepare a nitro-compound from orcin, but hitherto without success—the orcin being converted, by strong nitric acid at ordinary temperatures, into resinous uncrystallisable compounds. When, however, colourless orcin in fine powder is gradually added to strong nitric acid cooled by a freezing mixture, it dissolves, with a pale brown colouration, but without the slightest evolution of nitrous fumes. If this solution be now slowly dropped into concentrated sulphuric acid cooled to a low temperature, the mixture becomes yellow and pasty, from the formation of the nitro-orcin, which is but slightly soluble in sulphuric acid. This is now poured into a considerable quantity of cold water, when the nitro body separates as a bright yellow crystalline powder, without any admixture of resin. One or two crystallisations from boiling-water suffice to render it quite pure. It is thus obtained in large yellow needles, which are soluble in alcohol, slightly soluble in cold water, but readily in hot. On analysis, it was found to have the composition corresponding to the formula—

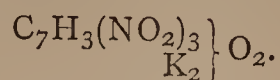


that of trinitro-orcin. It is a powerful acid, much resembling picric acid, but distinguished from the latter by the solubility of its salts; I therefore propose to call this new substance *trinitro-orcinic acid*.

*Trinitro-orcinic acid of Potassium*.—This is readily prepared from trinitro-orcinic acid, by dissolving it in a warm and rather concentrated solution of potassic carbonate. On cooling, it solidifies to a crystalline mass of fine needles.



of a deep orange colour. The salt, dried at 100° C., has the composition—



The sodium-, calcium-, and silver-salts of this acid all crystallise well, and are tolerably soluble in water; the lead-salt is much less soluble.

*Trinitro-resorcinic Acid*.—Resorcin, prepared from galbanum by the excellent method given by its discoverers, Hlasiwitz and Barth, was treated with nitric and sulphuric acids, in precisely the same manner as that above described for orcin, and with similar results. Trinitro-resorcinic acid, when pure, crystallises readily, but is of a much paler colour than trinitro-orcinic acid, which it closely resembles in most of its properties. Analyses of the substance showed its composition to be  $\text{C}_6\text{H}_3(\text{NO}_2)_3\text{O}_2$ . It readily forms crystalline salts.

*Trinitro-betaorcinic Acid*.—Betaorcin,  $\text{C}_8\text{H}_{10}\text{O}_2$ , when treated with nitric and sulphuric acids as above described, gives a yellow substance, which appears to be the corresponding nitro compound of betaorcin; but, from the small amount of material at my disposal, I am at present unable to accurately determine its properties.

From some experiments I have made, the action of reducing agents, nitrous acid, &c., upon the nitro-compounds promise very interesting results; these, together with the preceding compounds, I am at present investigating.

The Laboratory, Rodney Street, Pentonville,  
August 23rd, 1870.

## EXAMPLES FOR PRACTICE IN QUANTITATIVE CHEMICAL ANALYSIS.\*

By FRANK H. STORER,  
Professor in Massachusetts Institute of Technology.

(Continued from p. 90).

### EXPERIMENT II.—Determination of Water and Sulphuric Acid in Gypsum.

To estimate the water, weigh out about 7 grms. of the finely-powdered mineral in a porcelain crucible of known weight. Heat the crucible over a Bunsen burner, at first gently, but afterward strongly. Allow the crucible to cool, and weigh it with its contents; again heat, cool, and weigh, and repeat these operations until the weight remains constant. Half an hour will be time enough for the whole work. The total loss of weight represents the water which the mineral contained. In our experiment 7.043 grms. of transparent, crystallised gypsum (*selenite*) lost 1.48 grms.

$$7.043 : 1.48 = 100 : 21.01 \text{ per cent.}$$

For the formula  $\text{CaSO}_4 + 2\text{H}_2\text{O}$ , theory requires 20.93 per cent of water.

To determine the sulphuric acid, transfer the ignited mineral in which the water has been determined from the crucible to a beaker of 600 or 700 c.c. capacity, pour upon it 100 c.c. of dilute chlorhydric acid (free from sulphuric acid), prepared by mixing 2 parts of water with 1 part of the strong acid. Heat the mixture twenty or thirty minutes, or until the gypsum has all disappeared. Pour in water enough to half fill the beaker, heat the solution nearly to boiling, and add to it a solution of chloride of barium, little by little, as long as any precipitate continues to fall. Stir the liquid continually with a glass rod while adding the chloride of barium, and during the subsequent heating, in order that no "bumping" may occur. After enough chloride of barium has been added, keep the liquor hot for five or ten minutes, then set it aside for ten or twelve hours in a moderately warm place, in order that the

particles of sulphate of barium may subside, and become somewhat compacted and coherent.

Pour the clear supernatant liquor upon a six-inch filter, wash the precipitate in the beaker by decantation, first with boiling water, then with a boiling solution of acetate of ammonium (to decompose and remove any chloride of barium which may have been dragged down in combination with the sulphate), and, finally, three or four times with boiling water. Then transfer the precipitate from the beaker to the filter, pour hot water upon it until all the chloride of calcium has been removed, so that a drop of the filtrate, carefully evaporated to dryness upon a slip of glass, leaves no residue. Dry, ignite, and weigh, as in the preceding experiment.

$$\begin{matrix} \text{Molec. wt.} & \text{Molec. wt.} & \text{The wt. of} & \text{Wt. of} \\ \text{of BaO, SO}_3 & \text{of SO}_3 & = \text{BaO.SO}_3 & : \text{SO}_3 \\ & & \text{found} & \text{therein.} \end{matrix}$$

From the aforesaid 7.043 grms. of mineral, there was obtained 9.5545 grms. of  $\text{BaO.SO}_3$  (= 3.28 grms.  $\text{SO}_3$ ).

$$7.043 : 3.28 = 100 : 46.57 \text{ per cent.}$$

Theory requires 46.51 per cent.

The percentage amount of oxide of calcium contained in the mineral was estimated "by the difference."  $100 - (21.01 + 46.57) = 32.42$ . Theory requires 32.56. The result of the analysis may be tabulated as follows:—

	Found.	Theory.
CaO (by difference) ..	32.42	32.56
SO <sub>3</sub> .. .. .	46.57	46.51
2H <sub>2</sub> O .. .. .	21.01	20.93
	100.00	100.00

(To be continued.)

## ON THE PREPARATION OF SPECIMENS OF SOUNDINGS FOR THE MICROSCOPE.\*

By Professor A. M. EDWARDS.

In the course of his gatherings it not unfrequently happens that the microscopist acquires specimens of the bottom of the ocean, from various localities, which, if properly prepared, furnish him with many beautiful objects for observation and study. And the beauty of these objects, the remains of once-living organisms, are of such a marked character and present so many points for admiration that, even to the unscientific observer, they become sources of pleasure often leading to farther enquiry into their life-history, so that imperceptibly almost, and by gradual degrees, the possessor becomes a student, in fact, and is induced to follow up his investigations to some practical end.

At the present time such specimens are of special interest, on account of the remarkable revelations made by the deep-sea dredging, lately carried on upon our coast and in Europe, and the bearing of these specimens upon Geology, Zoology, as well as other branches of science. The immense tracts covered by what Dr. Carpenter has characteristically termed "Globigerina-mud," on account of it teeming with *Foraminifera* so called and the connection of Prof. Huxley's "Coccoliths and Coccospheres," with the formation of the chalk-beds of the Cretaceous, open up to the microscopists an universe of new facts for investigation. Added to these calcareous organisms, the specimens of sea-bottom presents us with siliceous forms, both animal and vegetable, of surprising delicacy and beauty of outline and structure, and it was to these last named that my attention has been more particularly turned.

\* From the *Proceedings of the Lyceum of Natural History, New York*.

\* Communicated by the Author. From the *Massachusetts Teacher*.



Among such specimens of sea-bottom, the soundings taken at different times, and at various points on the coast of the United States by the Coast Survey, have been subjects of extreme value to the scientific observer, while they have, at the same time, furnished many unscientific possessors of microscopes with matter for admiration, wonderment, and joy; the graceful *Diatomaceæ*, the symmetrical *Radiolaria*, and marvellous *Foraminifera*, often present in such profusion, serving to enable the preparer to put up slides of surpassing beauty.

One of these soundings, for which I am indebted to the Smithsonian Institution, was of such a character that I was extremely desirous of studying as completely as possible the forms presented in it, belonging, as they did, to all of the three families mentioned, besides which it contained several minute mollusca and the remains of sponges and other organisms. It was, as shown by the remains present, of such a character as to consist essentially of calcium carbonate, commonly known as carbonate of lime, and silicon dioxide (silica), built up into the skeletons of dead organisms. The problem, then, presented to me, was to prepare it in such a way, if possible, first, to show all of these objects at the same time, or, second, to separate it into calcareous and siliceous specimens, and this last method I found, after trial, to be the best. As my mode of manipulation may hereafter be of value to others possessing similar gatherings, I will give it in detail.

The sounding, being in the shape of a dry powder of a light greyish-green colour, was placed in a suitable glass vessel and moderately strong liquor potassa poured upon it. It was now boiled for a few moments, until I saw that the lumps present in it were broken up, and a light mud-like sediment was the result. The solution of potassa must be, of course, apportioned in strength to the specimen under manipulation; such as consists of many lumps and much organic matter will require it of greater strength than that which is mostly calcareous and siliceous. If it be used too strong, some of the more delicate siliceous forms will be attacked, or even, as I have occasionally found, entirely dissolved. After it had boiled for a short time, as I have said, I allowed it to stand until the mud had settled, and a tolerably clear solution was left above it. I now poured off most of the liquor potassa, and replaced it by a strong solution of chloride of soda, so-called. That sold by apothecaries under the name of "Labarraque's solution" will answer generally, and is readily procured. This I now boiled until I found its action to cease. By this means the mud is so much bleached as to become almost white. The potassa, at first, has the effect of dissolving much of the organic matter present, and thus breaking up the lumps and setting the shells free, and the chloride of soda solution bleaches them, so that we have them clean and separated to such an extent that, under the microscope, the individual shells are easily recognised. I now proceeded to separate the larger from the smaller forms by means of the "elutriation" process, which consists in first washing off thoroughly all the potassa and chloride of soda with pure filtered or distilled water, and shaking up the sediment in a glass about two inches high filled also with water. If now permitted to stand for a few seconds, the larger forms and coarser sand settles, and the supernatant liquid can be poured off into another larger vessel. Again, water is added to the first sediment, and, in turn, removed, and this is done as many as six or eight times, until we see that the coarse sediment is not contaminated by finer particles by the water it is shaken in remaining almost clear. The same process is carried out with the sediment in the second vessel, only permitting each charge of water to stand longer than in the first case, as the forms are now much smaller and require longer to settle. In this way we may get three or four densities of sediment, although I found that my specimen yielded but two which contained anything of interest of a calcareous nature. After, then, setting aside the two first sediments, I carefully acted upon

what was left with hydrogen nitrate (nitric acid), and procured a small quantity of a sediment, consisting, for the most part, of nothing but the siliceous lorica of *Diatomaceæ*. They were very few, however; so, to procure all the remains of *Diatomaceæ* and other siliceous organisms present in the gathering, I took a quantity in the rough state, and, after breaking it down by potassa, acted on it with boiling hydrogen nitrate. Thus I found that I had good representatives of all the gathering contained. Some specimens, however, are not thoroughly cleaned by boiling, even for a considerable length of time in strong hydrogen nitrate. To such I add either hydrogen chloride alone or a few grains of finely-pulverised potassium dichromate. In this way, and after thoroughly washing with pure water, I have been enabled to obtain extremely beautiful specimens of *Diatomaceæ*, *Radiolaria*, and other siliceous organisms in a good condition for studying them. This I am engaged upon at the present time, and intend, before long, to lay the results before the Lyceum.

## ON THE ANILINE OR COAL-TAR COLOURS.\*

By W. H. PERKIN, F.R.S.

(Concluded from p. 93.)

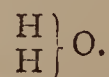
I HAVE in these lectures brought before you, in a rapid—I fear too rapid—manner, an account of most of the coal-tar colours; but, before concluding, I should like to show you the close relationship which exists between some of them, especially between those derived from rosaniline or magenta.

I have endeavoured to show you that the derivatives of magenta closely agree in properties, all of them containing colourless organic bases, the colour being developed upon their combining with acids. But I now wish to show you more than this, by briefly explaining their chemical structure. To describe this thoroughly, it would be necessary for me to enter fully into the chemical theory of substitution; but, as this would occupy a great deal of time, I must content myself with just mentioning a few facts connected with that subject.

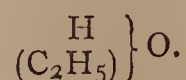
Rosaniline and its derivatives contain carbon, hydrogen, and nitrogen, as I have told you on a previous occasion. Chemical substances containing hydrogen often hold it in what is termed a replaceable condition—that is, in such a condition that it may easily be removed—and another substance of equal value (either simple or compound) introduced in its place. A compound substance capable of replacing hydrogen is called a "radical"; and I want to speak about two of these radicals, one called ethyl, and contained in iodide of ethyl, the other called phenyl, and contained in aniline.

Ethyl contains  $C_2H_5$ .  
Phenyl     ,,      $C_6H_5$ .

I will first mention a familiar instance of the replacement of hydrogen by a radical. Water is composed of two equivalents of hydrogen and one of oxygen, thus—



Now, it is quite easy to remove an equivalent of this hydrogen and replace it by ethyl.

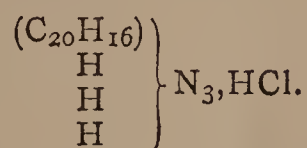


This is water with hydrogen replaced by ethyl, a replacement compound by some very much preferred to water itself; it is alcohol.

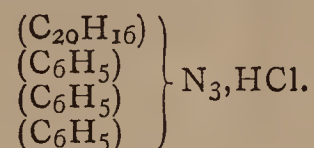
\* The Cantor lectures, delivered before the Society of Arts.



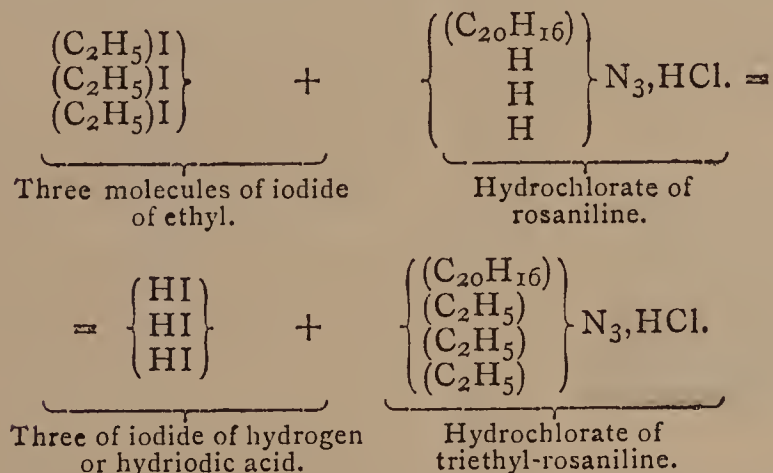
Rosaniline contains three equivalents of hydrogen, replaceable by radicals. This is the formula of the hydrochlorate of rosaniline, the three separate H's being replaceable:—



Now, what takes place upon boiling this salt with aniline? The phenyl of the aniline simply takes the place of the replaceable hydrogen, producing what is called triphenyl-rostaniline. The result of this replacement is that the rosaniline salt has been changed from red into blue—the bleu de Lyon—which is represented thus:—

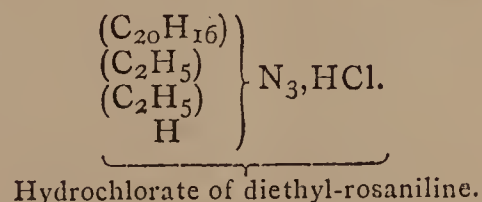


Dr. Hofmann, on observing this relationship, was induced to try whether he could replace the hydrogen in rosaniline by other radicals than phenyl. He tried to introduce ethyl by digesting rosaniline with iodide of ethyl, and succeeded in introducing three molecules of the radical ethyl in the place of the three replaceable hydrogens. I will endeavour to show you how this takes place, by the following equation:—

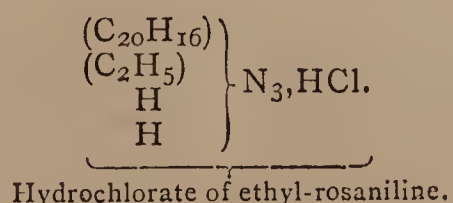


Here we see the iodine has simply exchanged its ethyl for the replaceable hydrogen of rosaniline, and the result is a blue shade of the Hofmann violet.

Now it is not necessary to replace the three hydrogens; two may be replaced, and we get a less blue violet, represented thus



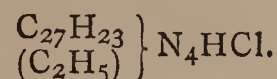
Or, one may be replaced, and we get a red-violet, represented thus—



When speaking of the violet imperial, I mentioned that it consisted of products intermediate between rosaniline and the bleu de Lyon. These intermediate substances consist of rosaniline with one or two equivalents of hydrogen replaced by phenyl.

Up to the present moment, it has only been found possible to replace one equivalent of hydrogen in mauveine, or the mauve dye; and, as I previously mentioned, it is curious that the result of this replacement is perfectly opposite to that which takes place in the case of rosaniline, the replacement of hydrogen by ethyl in rosaniline causing it to become bluer in shade, and the replacement of hydrogen by ethyl in mauveine causing it

to become redder in shade. The following is the formula of the hydrochlorate of ethyl-mauveine or dahlia:—



But, although I have tried to explain the relationship of these colouring matters as simply as I can, yet this part of my lecture assumes much of the character of a lecture on theoretical chemistry. Here we are talking about substitution products of bodies, a branch of the highest theoretical chemistry, and it must strike us as remarkable, when we find that these considerations have been pressed upon us by the discussion of bodies which may now be said to be common dye-stuffs. We have also been talking quite in a familiar manner about nitrobenzol, aniline, iodide of ethyl, aldehyde, &c., substances which were, only a few years since, the *recherche* compounds of the laboratory. In fact, the coal-tar colour industry is entirely the fruit of theoretical chemistry. Let us consider the enormous rapidity with which this industry has developed. It only dates from 1856, and now we have large factories for the production of coal-tar colours, not only in Great Britain, but in Germany, France, Switzerland, America, and other countries. I had hoped to have been able to give you a statistical account of this industry, but have not had sufficient time for this purpose. Dr. Hofmann, however, in his report on the coal-tar colours shown at the Paris Exhibition of 1867, remarks that, "in 1862, the value of these manufactures had risen from nothing to 10,000,000 of francs, or more than £400,000 sterling. At the present day this sum is trebled, which would make it about one million and a quarter pounds sterling, although the products are much cheaper than they were before." And now, when you hear of these results, do not forget that they are the truly practical fruits of theoretical chemistry, not studied for the purpose of producing commercial products, but simply for its own sake.

## THE DETERMINATION OF COMBINED CARBON IN IRON AND STEEL BY THE CCLORIMETRIC PROCESS.\*

By J. BLODGET BRITTON,  
Of the Iron-Masters' Laboratory.

LONG ago Professor Eggertz, of Fahlun, Sweden, called the attention of metallurgical chemists to the fact that when pure metallic iron is dissolved in nitric acid, of common strength, the solution, if not too concentrated, is colourless, or nearly so; but when steel, or iron containing carbon in combination, is substituted for the pure metal, the solution is coloured, and the shade varies exactly in proportion to the amount of carbon present; and, based upon this fact, he suggested a method whereby carbon determinations, sufficiently accurate for many commercial purposes, could be made with facility.

Several modifications of this method have been proposed. One of them, affording exceedingly accurate results, has been in use at the Iron-Masters' Laboratory for some time. Instead of a single tube, containing a standard solution for comparison, as suggested by Eggertz, a number of tubes having their solutions differently standardised, one from the other, are employed. These are arranged securely in a walnut-wood frame, with spaces between for placing the tube containing the solution to be tested, and forming together a convenient portable instrument called a colorimeter—an exact representation of such an instrument is here annexed. The position of the tube containing the solution to be tested is shown at A.

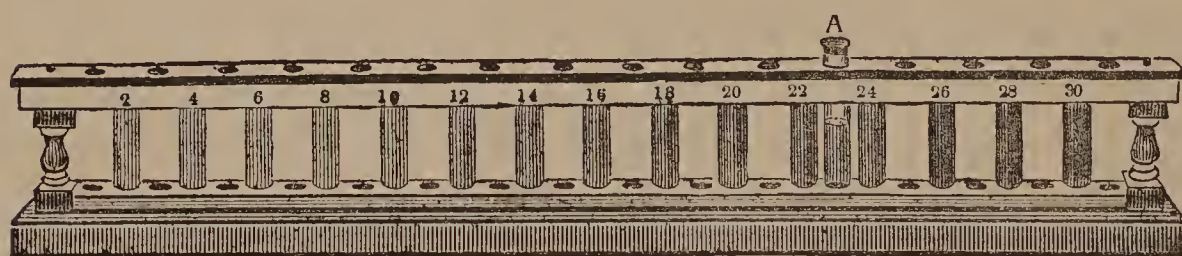
\* Communicated by Professor Morton. From advance-sheets of the *Journal of the Franklin Institute*.



The tubes are  $\frac{3}{8}$ ths of an inch in diameter, and  $3\frac{1}{2}$  inches in length, filled with water and alcohol coloured with roasted coffee, and hermetically sealed. The solution in the tube to the left has its colour to correspond exactly with one produced by 1 grm. of iron, containing 0.02 per cent of combined carbon, dissolved in 15 c.c. of nitric acid. The solution in the tube next to it has its colour to correspond with one produced by the same quantity of iron, but containing 0.04 per cent of combined carbon, and so with each of the other tubes, increasing 0.02 per cent of carbon in regular succession to the right, the last reaching 0.3 per cent as indicated by the figures on the upper rail of the instrument.

On the back of the instrument, and for the purpose of partially screening the light and allowing the different shades of colour to be distinctly discerned, there is tightly stretched between the rails some fine white parchment paper. This screen is not shown by the cut, but it serves a very important purpose.

The process is conducted as follows:—1 grm. of the finely divided metal is put into a tube of about  $1\frac{1}{2}$  inches in diameter and 10 inches long, and digested for fifteen or twenty minutes in 10 c.c. of nitric acid of a little more than 1.20 sp. gr. free from chlorine. The solution is then cautiously poured into a beaker, and a small portion of metal which remains undissolved and adheres to the bottom of the tube, is treated with 5 c.c. of fresh acid and exposed to a gentle heat till completely dissolved and added to the other. The contents of the beaker, when sufficiently cool, are filtered through two thicknesses of German paper (not previously moistened and of a diameter not exceeding  $4\frac{1}{2}$  inches) into a tube about 5 inches long



and of precisely the same diameter as those in the instrument.

After the filtered solution has remained for some minutes, at the temperature of the atmosphere, and its colour become fixed, the tube is placed in the instrument and the carbon determined by a comparison of shades;—the determination may be made readily as close as 0.01 per cent.

Heat should not be applied in the first instance to facilitate the solution of the metal, because a high temperature is apt to cause a slight loss of colour. Two thicknesses of paper are taken because one alone is liable to break; and the paper should be used dry, for, if previously wetted, the water will weaken the colour of the solution, and it ought to be cut to a size not exceeding  $4\frac{1}{2}$  inches to prevent undue absorption.

If the metal to be examined contains more than 30 per cent of carbon, 0.5 grm. or less of it, may be taken, or the solution may be diluted with an equal volume or more of water and the proper allowance made; or an instrument of higher range may be used. On the other hand, if the metal contains a very small per cent of carbon, 2 grms. of it may be taken. For preparing the standard solutions (the normal ones begin to lose colour after some hours), caramel dissolved in equal parts of water and alcohol, as suggested by Eggertz, answers well; but with roasted coffee as the colouring matter I have succeeded in obtaining the true shades. I must say, however, that this latter solution has not been in use sufficiently long to allow me to positively assert that its colour will not change after some length of time. As a rule, the instruments are kept in the dark, except when in actual use, and no perceptible change has yet taken place.

## ON THE TEMPERATURE AND HEATING-POWERS OF FLAMES.

By Professor H. WURTZ.

In the CHEMICAL NEWS of June 24, there is a communication (said to be copied from the *Philosophical Magazine*, which latter I have not yet seen), with criticisms by W. M. Watts, D.Sc., upon the paper of Professor Silliman and myself on the "Calorific Powers or Effects of Gases," read to the American Association at Salem in August of last year, as forming the *introductory part* of a pending investigation on the important practical subject of the temperatures of the flames of such gases as are ordinarily employed for heating and lighting purposes. This paper was published in the previous issue of the CHEMICAL NEWS.

Mr. Watts accuses us, first, of "confusion" between heating-powers and flame-temperatures, not observing that this introductory paper is confined to heating-powers or effects, the subject of temperatures being left to future occasions; hence he betrays inattention to our paper, if not confusion of ideas on his own part, when he suggests to us, in a note, that in our first conclusion on the heating *effect* of carbonic oxide, we really mean the "flame-temperature" thereof. Such a change in our wording would be confusion indeed. The temperature of an open flame is usually highly variable in various parts, and we have applied the term "flame-temperature" to that of the hottest zone only. I believe that to any attentive reader, not anxious to pick flaws, our meaning

in the use of the term maximum *calorific effect* must be manifest; namely, the total and final amount of heat (so to speak) or heating result, after total combustion, without regard to *time* or rapidity of combustion, of which, of course, the temperature is a function.

Mr. Watts's reasoning against our result as to the heating effect (*called by him flame-temperature*) of olefiant

gas being lower than that of carbonic oxide, especially compels me to think that he has not read our paper with that attention which so confident a criticism should imply. This reasoning may apply, partially at least, to the case of the combustion of these two gases with the necessary amount of *pure oxygen*, being then essentially a re-statement (though not complete) of the conditions of the actual experiments of Favre and Silbermann, but is wide of any application to our own case, in which the *nitrogen of the air* plays a large part. In burning in the air, as a simple calculation shows, one volume of CO has to heat but two volumes of N and half a volume of O, whereas one volume of olefiant has to heat more than 11 (exactly 11.29) volumes of N and three volumes of O, or 14.29 volumes altogether, up to the temperature of its flame, or of the body heated thereby. Thus in the case of aerial combustion, the total heat of the olefiant volume is distributed or *divided* throughout 5.72 times greater bulk of air than is the case with carbonic oxide. Hence (in part) the lower calorific effect of olefiant in air, even when the latent heat of the steam of combustion is recovered by condensation. Of these, with other things, Mr. Watts takes no heed, and, in view thereof, I think that we can justly retort his accusation of "confusion."

As to the correction necessary in Bunsen's gasometry, for the heat of the steam of combustion of hydrogen, we were informed that this had been made, but not by whom. Our informant, Professor Cooke, of Cambridge, thought by Bunsen himself, but we were unable to verify this, and in a note to our paper, as published in the *American Journal of Science* (p. 342) referred to the subject somewhat doubtfully. Our thanks are therefore due to Mr. Watts for the reference to Dibbitts.

The exception made by Mr. Watts to the formula



for the total calorific of hydrogen relating to the correction for the difference between the specific heats of water and steam, is one which I cannot at present individually enter upon, and to which I shall again return. I will merely say that there has been controversy upon the points here involved; mentioning, also, that the number calculated by Deville, for the total calorific power of hydrogen in oxygen is 6800°, which is about the mean between Mr. Watts, and the figure adopted by us (See *Revue des Cours Scientifiques*, March 13th, 1869, p. 232).

As to the comments made on our conclusion regarding carbonic oxide, that "of all known gases" it gives the highest calorific effects, I am quite ready to confess that Mr. Watts has convicted us of a lack of precision of language which we ought to have avoided. We may, however, plead in mitigation, that our paper was more especially intended to introduce the subject to *practical men*, in available forms; and that we, therefore, with an inadvertence not wholly excusable, held in mind only such gases as are met with appreciably in practice. Mr. Watts therefore puts us again under obligation here.

Some readers will doubtless conclude, from Mr. Watts's last paragraph, that he suspects Professor Silliman and myself of ignorance regarding the experiments of Bunsen and Deville on the actual temperatures of the flames of hydrogen and carbonic oxide. The readers of this journal will not heed such an insinuation, in view of discussions by the present writer, of the researches of these two chemists, that have appeared in these columns, antedating the presentation of the joint Salem paper. (See particularly *American Gas-Light Journal* of August 2nd, 1869, p. 34.) One sentence in that paper might, I should think, have presented such an impression on the part of Mr. Watts. This is where we say that our figure 6851° C. "is the temperature actually possible in the flame of the compound blow-pipe *were the combustion instantaneous and complete*" (the italics being in the original). The subject belonging, however, to that of flame-temperatures, which we had not as yet strictly entered upon, was deferred by us for the time being.

Finally, I cannot but submit that Mr. Watts in presenting his concluding table, has in several ways inadvertently laid himself open to criticism of a class similar to most of that applied to us, including the accusation of confusion of ideas and terms. I shall be satisfied with respectfully presenting two questions. If the second column comprises the actual flame-temperatures, as determined by experiment, why does he designate the first column also "flame-temperatures"? Are not these latter figures precisely what *we* have designated as total *calorific powers* or *effects*, instead of temperatures?

#### ON THE EFFECTS OF THE APPLICATION OF THE HOT BLAST TO BLOWPIPE PURPOSES:

AND THE PROPOSED SUBSTITUTION OF HEATED AIR FOR  
OXYGEN IN THE PRODUCTION OF CERTAIN THERMAL  
AND ILLUMINATING EFFECTS.

By W. SKEY,  
Analyst to the Geological Survey of New Zealand.

THE useful and well-known effects of the hot blast, in the process of iron smelting, has induced me to try and extend it profitably to other purposes, beyond that which prompted its application in the present instance.

My experiments, as yet, have been confined to testing the effects of substituting a hot blast for a cold one, as hitherto used, for the production of the well-known blow-pipe flame; a flame so produced will be expected to have its thermal and illuminating effects augmented, but scarcely,

perhaps, to that degree which experiment has demonstrated.

I had better state, at the outset, those particulars which it is necessary to know, before relating the results.

The temperature of the blast was, approximately, 500° F.; the diameter of the jet, regulating its issue, was 1-30th of an inch; the combustible for receiving the blast was stearine.

This flame manifested a very marked superiority over the common blowpipe flame—substances difficult to fuse in the latter, magnetite, potash-felspar, mica, readily yielded under these circumstances; while thick glass tubes, half an inch in diameter, and hard German glass tubes, were tractable to an eminent degree.

Carrying my test experiments still further, I found several substances, for the fusion of which the oxyhydrogen flame, or some equivalent of it in heating power, is said to be indispensable, also yielded before the blowpipe-flame thus urged: for instance, platinum, pipe-clay, fire-clay, agate, opal, flint.

Several samples of each were tried, and always with the same results; it could not well be, therefore, that the fusibility of any of these substances was due to the accidental presence of foreign matter, in more than usual quantity.

The platinum was the common platinum foil, also a sample prepared especially for the purpose; the only impurity found in it was iron, as traces, communicated to it in the act of forging; possibly minute quantities of some of the other metals of the platinum series might be present, but they would rather tend to increase its infusibility than otherwise.

Alumina only appeared to vitrify; while, after numerous trials with crystallised quartz, I could not succeed in fusing it to a globule; thin splinters, however, curled round upon themselves, like scapolite, and ultimately assumed a glazed appearance, clearly showing that the melting-point was all but reached.

It appears, from this, that a very small amount of some foreign substances exercises a marked effect upon the fusibility of silica, agate, opal, &c., being only a little less pure than rock crystal, though so readily fusible in this flame.

Regarding the illuminating power of the flame so produced, when allowed to impinge upon a solid substance, such as lime or magnesia, it was not only more intense (as would be expected), but the volume of incandescent matter was largely increased.

Before I proceed to urge the further use of hot air for combustions, where high temperatures are necessary, I wish to call attention to the fact, that the temperature of the flame, which I have hitherto worked with, can be largely and economically increased by increasing that of the blast; this can easily be done to a threefold extent.

By substituting heated hydrogen (or burnt coal-gas), I have also realised all the effects just instanced, with greater rapidity and decision; but the great diffusiveness of this gas, especially when heated, has prevented me, as yet, carrying the experiments further.

While on the subject of heating both combustibles (at least, both the substances which take part in these combustions), I cannot refrain from remarking how easily the temperature of the oxyhydrogen flame, even, could be increased in this manner—the gases would, of course, have to be heated prior to contact. Upon their more vigorous diffusiveness, when rarefied, I should rely for that solidity of flame so necessary where the communication of very high temperature is desired. The jets regulating the issue of the gases would have to be very fine.

Proceeding now to the next part of this subject: the result of these experiments, instanced, urge me to recommend, for trial, the substitution of heated air for oxygen, in most of those cases where this gas is now employed in conjunction with hydrogen, or other combustible matter, as a generator of heat or light: for instance—



1. In the metallurgy of platinum, that part of it where the metal has to be fused; also in soldering platinum stills for sulphuric acid works.

2. The fusion of alumina in the manufacture of certain gems.

3. In the production of the Drummond and Bude lights.

The fusion of platinum and alumina is now effected by the oxyhydrogen flame.

Relative to the competency of heated air to perform the part of cold oxygen in the production of such intense lights as these (the Drummond and the Bude), I think this can be demonstrated, almost to a certainty, in the following way:—

Thus—the flame employed in these investigations has certainly a minimum temperature of  $4596^{\circ}$  F., since this is the fusing point of platinum, the substance most easily fused of all those I have tried that are infusible in the common flame; doubtless the temperature is considerably higher, but I will take these figures. On the other hand, the actual temperature of the lime, when the Drummond light is in operation, is (on the authority of Tyndall) only  $2000^{\circ}$  C. =  $3632^{\circ}$  F.; hence this flame has an excess of temperature over that of the incandescent lime equal to  $964^{\circ}$  F., a pretty good margin for loss, surely sufficient if properly economised; but as I have already shown, this excess of temperature can be largely increased.

In view of the greater controllability of the proposed substitute, the absence of all danger in its use, its not requiring chemical preparation, and its cheapness, compared with oxygen; upon these several points, respectively, the question should be properly tested.

Besides the substitution of oxygen urged above, the possible fusion of the purer clays, and certain silicas, &c., in a ready and economical manner, may induce the further utilisation of these substances, while, in experimental chemistry, the facility with which such high temperatures can be attained and kept up may lead, among other things, to some cheaper way of extracting certain metals from their oxides—aluminium, for instance, from alumina or clay.

On reviewing these results, it does seem not a little singular that a difference of not more than  $500^{\circ}$  F. in the temperature of the blast should make the difference between the fusibility and infusibility, of such substances as platina, agate, fire-clay, &c., in the blowpipe flame. It will be recollected, however, that the blast has, in this case, not only taken up the heat required to raise a single volume of it to this temperature, but another portion of heat has been taken up in a latent form, as the air expanded,—consumed as it were in lifting against the atmospheric pressure; this may be represented sufficiently well for us, by assuming the temperature of the blast, kept to its normal volume, at  $700^{\circ}$  F.

This is as yet, however, but a very slight addition to produce results, which so nearly approximate to those obtainable by the oxyhydrogen flame, seeing the latter has an estimated temperature of  $14,000$  to  $15,000^{\circ}$  F., while that of the present method does not much exceed  $5000^{\circ}$  F. The gap, as far as effects is concerned, is narrowed so much, and in a manner so unexpected, by the results here given, that one is naturally prompted to enquire whether the assigned temperature of the oxyhydrogen flame has been obtained by direct experiment, or by calculations, based upon the ascertained temperature of other flames. The temperature as calculated, indirectly, in this last way, certainly furnishes us with figures remarkably close to those just quoted.

In reference to this important point I beg to call attention to a notice, which appeared in the CHEMICAL NEWS, relative to the imperfect combustion of certain gases at high temperatures.

There we learn that at moderately high temperatures

(much below  $10,000^{\circ}$  F.) oxygen and hydrogen only very partially combine,—from memory, I believe, not more than to the extent of half their weight,—the remainder of the gases of course combine, as the centre of heat is left behind. Thus, although the quantity of heat evolved by their combustion is the same, being divided over a larger volume, its intensity is proportionately diminished.

This being so, it would seem to follow that the temperature of the oxyhydrogen flame must be very considerably lower than that hitherto ascribed to it; and, therefore, the possibility of substituting it in this, or in some other manner equally economical, for the several purposes here specified, appears so much the greater.

## OBITUARY.

DR. P. BOLLEY.

WE regret to learn that Dr. Bolley, the celebrated chemist and technologist, died suddenly on the 3rd inst. The deceased was born at Heidelberg, in 1812; received his preliminary and university education in his native town; and, in 1836, took the degree of Ph.D. For some time after that period, he was the first assistant of the late Professor Gmelin; in 1838, he was appointed Professor of Chemistry of the Cantonal School of Aargau (Switzerland); while, in 1843, he was elected Director of the Polytechnic School of that town. These positions he exchanged, in 1854, for his appointment of Professor of Chemistry and Technology at the Federal Polytechnic School, at Zurich, after having first become, in 1850, a naturalised Swiss citizen. From 1859 to 1866, Dr. Bolley was Director of this school, which difficult post he filled to the full satisfaction of the Swiss Federal Government, and, by his exertions, this institution became one of the most prosperous and most frequented of the Continent, the number of pupils having increased from 109 to 550, among whom were 314 foreigners from almost all parts of the world, including such remote countries as Chili, Peru, &c. In the years 1851 and 1862, the deceased was sent to London by the Swiss Federal Government to report upon the exhibitions; and, in 1867, he visited Paris for the same purpose. Dr. Bolley's published works are very numerous. He first started, and was for some time chief editor of, the *Schweizerische Gewerbeblatt* (from 1840, and continued to the present day); he was also one of the chief contributors to the *Schweizerische Polytechnische Zeitschrift*; and, in company with several eminent savants, he edited a most complete and valuable work on Chemical Technology, in the German language, of which work he had, just before his death, finished the section on Natural and Artificial Dyes and Pigments. Dr. Bolley also published a Manual of Technico-Chemical Research, which was originally issued in the German language, but has been translated into English and French. The deceased was highly respected in every way, and his sudden demise is a very great loss to the Helvetian Republic, of which he was an eminently useful and valued citizen. As might be expected, the deceased was a member of very many scientific societies in various countries. The Swiss Federal Polytechnic School above alluded to is an institution established at the expense of all the Swiss cantons, jointly, and under the chief management of a committee, elected from among the national council for a period of five consecutive years; the Director of the school is the chief executive of the establishment, under the aforesaid committee, among which generally scientific men of note are found as members. This school is arranged upon the plan of that adopted for the school alluded to in the CHEMICAL NEWS, vol. xxii., p. 58.



## PROCEEDINGS OF SOCIETIES.

### ROYAL INSTITUTION OF GREAT BRITAIN.

*Notes of a Course of Seven Lectures on Electrical Phenomena and Theories.* By Professor TYNDALL, LL.D., F.R.S.

(Continued from p. 68.)

#### *Electric Polarisation: Ritter's Secondary Pile.*

234. When an electric current is sent through acidulated water a film of oxygen covers the positive electrode, and a film of hydrogen covers the negative electrode. One of these two substances being electro-positive, and the other electro-negative, they act in the liquid like two different metals; the hydrogen plays the part of zinc, and the oxygen plays the part of platinum.

235. Interrupting the primary battery circuit, and uniting together the two plates covered with their respective films, an electric current is obtained.

236. The direction of this current is from the hydrogen film to the oxygen film in the liquid, and from the oxygen film to the hydrogen film through the connecting wire.

237. Two electrodes thus covered with condensed gaseous films are said to be *polarised*: and the currents obtained from them are called currents of polarisation.

238. Now the battery current being always from oxygen to hydrogen (see Note 211), it is plain that the current of polarisation is always opposite in direction to the battery current employed to polarise the electrodes.

239. When a decomposition cell with platinum plates is introduced into a voltaic circuit, it is found that the battery current, though strong at starting, gradually sinks. This sinking is due to the gradual development of the antagonistic current of polarisation.

240. Also in the cells of the battery itself this current of polarisation may come prejudicially into play. When two metals, say zinc and platinum, and one liquid, say acidulated water, are employed, the platinum plate is coated with a film of hydrogen.

241. This hydrogen, being electro-positive, resembles a plate of zinc, so that when it is present we have, as it were, zinc opposed to zinc in the battery.

242. Were both plates actually of zinc we could have no current; and with the hydrogen film which approximates to zinc we have only a feeble current. To get the full effect of the zinc and platinum some means must be devised to remove from the platinum its film of hydrogen.

243. This is effected in Grove's battery by the employment of *two liquids*. The one is strong nitric acid, which contains the plate of platinum; the other is dilute sulphuric acid, which contains the plate of zinc. The nitric acid is placed in a vessel of porous earthenware, which becomes saturated with the liquid and allows the current to pass through it.

244. When the current passes, the hydrogen liberated at the platinum electrode in Grove's cell is instantly oxidised by the nitric acid, and prevented from forming a film upon the surface of the platinum.

245. If instead of employing a single decomposition cell and a single pair of platinum electrodes, we employ a series of such cells, and send the same current through them all, we convert every pair of such plates into an active voltaic couple; and if the number of such couples be great, effects of great intensity may be obtained.

246. If instead of using decomposition cells we simply employ a series of plates of the same metal, say a series of half-crowns, separated from each other by pieces of bibulous paper or by bits of cloth wetted with acidulated water; on sending a voltaic current through such a pile of plates, we liberate on one of the surfaces of each plate a film of oxygen, and on the other surface a film of hydrogen. These play the part of the two different metals in the pile of Volta.

247. The electro-motive force of such a pile may be far greater than that of the battery which charges it. It may produce a far more brilliant spark, and urge its current against resistances which would be quite insuperable to the original battery current.

248. The discoverer of this form of pile was Ritter; it is sometimes called *the secondary pile*, to distinguish it from the battery which charges it.

#### *Faraday's Electrolytic Law.*

249. When the self-same current is sent through a series of cells containing various compound liquids, the same amount of liquid is not decomposed in all cases.

250. Let the current be sent in succession through a series of cells containing water, oxide of lead, chloride of lead, iodide of lead, and chloride of silver; then taking them in the above order, the weights of the liquids decomposed are represented by the numbers 9, 111.5, 139, 230.5, 143.5.

251. The question now is, how are these weights of the respective substances divided between the two electrodes? Supposing the numbers to express grains, we should have the following division between the electrodes:—

At the positive electrode.		At the negative electrode.	
Grains.		Grains.	
Water.. ..	8.0	oxygen ..	1.0
Oxide of lead ..	8.0	hydrogen ..	103.5
Chloride of lead .	35.5	lead ..	103.5
Iodide of lead ..	127.0	chlorine ..	103.5
Chloride of silver	35.5	iodine ..	108.0
		silver ..	

252. Now these numbers express the combining proportions of the respective substances; by the electric current in all cases the law of combination as regards quantity is exactly inverted. The substances combine in equivalent proportions; they are decomposed in precisely the same proportions. This is the celebrated law of electrolysis discovered by Faraday.

253. In no case in the body of the electrolyte is any decomposition observed; in no case is any gas there liberated. The substances set free appear at the electrodes, and there alone.

254. Taking water as an illustration, the process is to be figured thus:—When the electrodes, charged with electricity from the battery, are plunged into the liquid, the oxygen atom of the water turns towards the positive, and the hydrogen atom towards the negative electrode.

255. If the electro-motive force be strong enough, the oxygen is torn away from its hydrogen; the free hydrogen immediately converges its attraction on the next adjacent oxygen atom, and unites with it, dislodging at the same time the hydrogen with which that atom had been previously combined. Another atom of hydrogen is thus liberated, which in its turn decomposes the adjacent water molecule. Thus through the chain of molecules run a series of decompositions, followed by immediate recompositions, until the negative electrode is reached. Here the hydrogen, having no further oxygen with which to combine, is liberated as a gas. This is the theory of Grotthuss, which, at all events, fairly embraces the facts.

#### *Nobili's Iris Rings.*

256. The hardness of steel in tempering it is judged by its colour, which is due to a film of oxide overspreading the steel. The oxide which forms on the surface of molten lead also shows vivid colours.

257. These are the colours of *thin plates* investigated by Newton and explained by Thomas Young.

258. By electro-chemical decomposition Nobili produced such colours in a very beautiful manner. Placing, for example, a polished steel plate in a dilute solution of acetate of lead, and connecting the plate with the positive pole of a voltaic battery, on dipping the end of a wire connected with the negative pole into the solution, the peroxide of lead is liberated on the surface of the steel immediately under the wire; and a film gradually diminishing in thickness spreads from that point outwards.



Round this point we have a series of concentric circles showing vivid iris colours.

259. These colours, like all those of thin plates, depend upon the thickness of the film, which diminishes as the distance traversed by the current increases.

(Du Bois-Reymond has shown that when the point from the negative end of the battery is very near the steel plate, the thickness of the film corresponding to the different circles is inversely proportional to the cubes of their radii.)

#### *Distribution of Heat in the Circuit.*

260. When the two ends of a voltaic battery are connected by a thick wire of good conducting material the wire is not sensibly heated; the heat due to the oxidation of the zinc is in this case confined to the battery itself.

261. But if the two ends of the battery be connected by a wire that offers a resistance to the current, the wire is heated, and may, if properly chosen, be raised to a white heat.

262. Considering the battery as the hearth where the zinc is burnt, we might be led to infer that the heat due to the combustion of the zinc is liberated on the hearth itself, and that its amount depends solely upon the quantity of zinc consumed.

263. This, however, is not the case. Let the battery, with its two ends united by a thick wire, be surrounded by a vessel of water, to which the heat developed by the oxidation, say of an ounce of zinc, is communicated; the quantity of heat developed is measured by the rise of temperature of the water.

264. Let the battery, with its two ends united by the resisting wire, be placed in the same vessel, and let the heat generated in the battery by the oxidation of an ounce of zinc be again determined; this heat will be less than that observed in the last experiment.

265. If the connecting wire be now enclosed in a separate vessel, and if the heat generated in the wire be thus determined, on adding this amount of heat to that liberated in the battery, a total heat is obtained exactly equal to that generated in the battery alone, when the good conducting wire was employed.

266. In fact, the absolute amount of heat generated by the oxidation of an ounce of zinc is perfectly constant; but it may be distributed in various proportions between the battery and the external circuit.

#### *Relation of Heat to Current and to Resistance.*

267. On what does the heat developed in a wire uniting the two ends of a voltaic battery depend?

268. It depends, in the first place, on the strength of the current, but it is not simply proportional to that strength.

269. Let the strengths of a series of currents, determined either by the tangent-compass or the voltameter, be represented by the numbers 1, 2, 3, 4, then the quantities of heat developed in the same wire by these respective currents are expressed by the numbers 1, 4, 9, and 16.

270. The heat generated is therefore proportional to the square of the strength of the current.

271. Preserving the strength of the current constant, the heat generated is proportional to the electrical resistance of the wire through which it passes. These important principles were established by Joule.

272. Thus if one of two equal currents pass through a silver wire, and the other through a platinum wire of the same length and thickness, the heat generated in the platinum will be ten times that generated in the silver, because the resistance of the former is ten times that of the latter. To urge the current through the platinum in this case would, however, require greater battery power than that necessary for the silver.

273. Hence, when the same current is sent through a wire composed of alternate lengths of silver and platinum

of equal thickness, the platinum spaces may be raised to a white heat, while the silver is not raised to the faintest glow.

(To be continued.)

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

*Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

*Comptes Rendus des Séances de l'Académie des Sciences*, August 16, 1870.

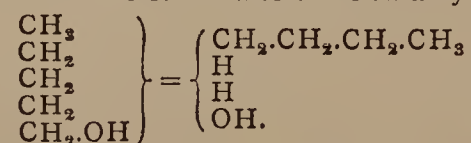
As may be expected, from various causes to which it is unnecessary to allude, this number is a very small one, the meeting of the Academy having only lasted about twenty minutes. The original papers and memoirs relating to physico-chemical and allied sciences are the following:—

**Decimal Division of Angles and Time.**—Y. Villarceau.—This lengthy paper contains a very concise review of the reasons in favour of the application (for scientific purposes, at least) of the decimal division of the objects alluded to.

**Reply to the Note of M. Jamin published in the preceding number of this Periodical.**—H. Sainte-Claire Deville.

**The Sun.**—Rev. Father A. Secchi, S.J.—The author, while passing through Paris, presents to the meeting his work on the above-named subject just published in the French language. This volume is divided into three parts; the first is devoted to the explanation of the modern means and methods of observation, and describes the structure of the sun; the second portion treats of the influence of the sun in the universe; while the third part describes the relations of the sun to the stars. The author states that he feels confident that this work contains everything relating to this subject which has been discovered and investigated by the various savants of the whole world who have devoted their labours to this matter.

**Normal Amylic Alcohol.**—A. Lieben and A. Rossi.—In order to prepare this new alcohol, the authors have first procured normal cyanide of butyl and the valeric acid corresponding thereto, which is isomeric with that produced by the oxidation of ordinary amylic alcohol. This new acid boils at 185°, and yields regularly-crystallised salts. The lime-salt of this new acid, having been mixed with formiate of lime, and submitted to dry distillation, produced an aldehyde which, on being hydrogenised, produced the new alcohol; this, in many of its properties, resembles the fermentation amylic alcohol, but differs therefrom by a higher boiling-point (137°). The authors have prepared, by well-known methods, the chloride, bromide, iodide, and acetate of amyl, all of which ethers differ from the ordinary amylic ethers by a higher boiling-point. The formula of this new amylic alcohol is—



**Experimental Researches on the Modifications of the Immediate Composition of Bones.**—F. Papillon.—The author relates, at length, some experiments instituted with live animals, to which were given, among their food, phosphate of strontia, phosphate of alumina, and phosphate of magnesia. These experiments were continued for several months, and the animals (pigeons and rats) which did not seem to be in the least affected by partaking of the small daily doses of the mineral matters alluded to, were killed, and their bones submitted to analysis, with the following results:—Ash of bones of pigeon, in 100 parts—Lime, 46.75; strontian, 8.45; phosphoric acid, 41.80; phosphate of magnesia, 1.80; residue, 1.10—total, 99.80. Bones of a rat, in 100 parts—Alumina, 6.95; lime, 41.10. Bones of another rat (to which phosphate of magnesia had been given), in 100 parts—Magnesia, 3.56; lime, 46.15.

*Bulletin Mensuel de la Société Chimique de Paris*, July, 1870.

From the *procès verbaux* of the meetings of this Society held in May last, and published in this number, we quote the following:—

**Researches on the Vapour Density of Perchloride of Phosphorus.**—Dr. Wurtz.—It is a known fact, says the author, that, when this compound is brought to the state of vapour, it is dissociated into protochloride of phosphorus and chlorine, in such a manner that its vapour occupies 4 volumes instead of 2. The author, thinking that this dissociation might be greatly retarded by the presence of a large ex-



cess of one or other of the products of this dissociation, has taken the vapour density of perchloride of phosphorus, by causing its vapour to be diffused through the vapour of protochloride, and, by this means, has obtained results coinciding with those which theory indicates for 2 volumes of vapour. The experiments were made according to M. Dumas's method, by introducing, into a previously-weighed glass balloon, perfectly dry perchloride of phosphorus, with an excess of protochloride, and heating to from 166° to 190° in a paraffin bath. The theoretical vapour density (2 volumes) is 7.2; the results of the experiments alluded to vary from 6.25 to 7.42.

**Action of Iodide of Cyanogen upon Oil of Turpentine.**—MM. de Clermont and Schutzenberger.—When these substances act upon each other at 60°, there is formed an iodine-containing liquid and a syrupy nitrogenous substance. The former body yields, when treated with an alcoholic solution of caustic potassa, or with moist oxide of silver, a solid camphor-like substance. When a cold ethereal solution of iodide of cyanogen acts upon the oil of turpentine, a tarry substance is obtained, and an iodine-containing liquid, which, if distilled in vacuum, explodes at about 100°. When iodine acts upon oil of turpentine, it appears that identical bodies are produced. The authors continue these researches.

This number contains, further, the following original papers:—

**Observations on the Critical Remarks made by M. Thomsen in reference to the Calorimetric Methods of MM. Favre and Silbermann.**—H. Sainte-Claire Deville.—This paper is written chiefly to prove that the mercurial calorimeter is a suitable and proper instrument for accurate experiments, if used according to the rules and indications given by M. Favre.

**Solid Cresol.**—A. Wurtz.—This paper contains the description of a process for obtaining the body alluded to, by treating hydrocarbons with sulphuric acid, and decomposing the conjugated sulpho-acids by potassa. The author states that he (as has been also observed by M. Barth, who has been experimenting on this subject) found that, during the reaction, some salicylic and paroxybenzoic acids are formed.

**Some Compounds Homologous with Tartaric and Malic Acids.**—H. Gal and J. Gay-Lussac.—This paper contains the following chapters:—Adipo-tartric, adipo-malic, subero-malic, and subero-tartric acids.

**Action of Chlorhydric Acid upon Osseine; New Researches for the Estimation of Osseine in Fossil-Bones.**—A. Scheurer-Kestner.—This paper is mainly a reproduction of the author's paper on this subject as published in the *Comptes Rendus*, and already abstracted therefrom by us.

**Manufacture of Tam-Tams, or Gongs, and Cymbals.**—A. Riche and P. Champion.—This paper contains an account of the method now followed for making the sound-producing instruments alluded to, which consist of an alloy of 80 parts of copper and 20 of tin, which is hammered out with frequent annealing. An alloy of 78 of copper and 22 of tin answers better, and can be rolled out. The process is similar to that in use in China, and is carried out at Paris by M. Cailar.

**New Series of Platinum Compounds.**—Dr. P. Schutzenberger.—This paper contains, at great length, all the particulars relating to a new series of platinum compounds discovered by the author, and already referred to by us from his paper in the *Comptes Rendus* on this subject.

**Abstract of a Memoir on the Volumes of the Chemical Equivalents.**—(First part.)—M. West.—This memoir consists of five parts, and treats of a statistic of more than 600 volumes of equivalents, the volumes being taken from all the densities mentioned in published classical works. This memoir is certainly of great value, but, unfortunately, not suited for any useful abstraction, and by far too lengthy for reproduction in full.

*Polytechnisches Journal von Dingler*, first number for July, 1870.

This number contains the following original papers and memoirs relating to chemistry and allied sciences:—

**Artificial Production of Cold by Compression and Expansion of Air.**—H. Bruhn.—This paper contains a review of the conditions required for the construction of machines contrived for the purpose of producing cold by the alternate compression and sudden expansion of air. The author proves that, although it might be possible to produce a very great cold by the means proposed, it fails to be economical in any respect.

**Injurious and Poisonous Action of the so-called Tar Colours.**—Drs. H. Eulenberg and H. Vohl.—The authors of this very lengthy memoir have, in writing it, kept in view the following points:—Is the pigment or dye prepared from substances which are by themselves poisonous? Has there been left in the pigment or dye any substance used during its preparation which, although not strictly belonging to the constitution of the pigment itself, is poisonous? Does the chemically-pure dye or pigment act injuriously on the animal body? Does the application and fixing of the dye to textile fabrics require mordants which are by themselves injurious, and a portion of which, either large or small, may remain in the fabric? The memoir is further divided into the following sections:—Aniline dyes; arsenical aniline green and picric acid; phenyl dyes.

**Experiments on the Activity of the Süvern Disinfectant.**—M. Hausmann.—The disinfectant alluded to consists of lime, chloride of magnesium, coal-tar, and water, in variable proportions. The mixture applied for experimenting contained, upon 240 parts of water, 100 of lime; 10, 40, or 70 of chloride of magnesium; and 6, 12, or 18 of

coal-tar. This mixture has been tried for the disinfection of foul canal water, with the result that 1000 parts, by weight, of the latter required 10 parts, by weight, of the disinfectant for complete purification. Some experiments were instituted with each of the essential constituents separately, to try their efficacy in this respect; lime alone seems to be most active. Nothing is said about the nature or cause of the foul state of the canal water alluded to.

**Purification of Oil of Turpentine.**—Dr. Grüner.—The author says that, even the most carefully rectified oil of turpentine leaves, when applied for cleaning tissues or leather, an unpleasant smell after its evaporation. He states that this is entirely obviated if the oil is rectified by distillation over tannin, but no rationale of the action of tannin is given. The tissues treated with this oil should be dried at a temperature of 65°, and no smell will adhere to them.

*Annales du Génie Civil*, July, 1870.

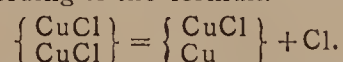
This number contains, in addition to a series of papers on engineering, the following paper relating to chemistry:—

**Madder: its Application to Dyeing and Printing.**—D. Kærpelin.—The first portion of a lengthy memoir, giving, in the first place an account of the history of the dispersion of madder from its native soil into Europe, where it was re-introduced from the Levant by the Dutch, in the 16th century. By order of Charles V. it was cultivated in the Alsace, and, since 1789, in the then Comtat d'Avignon (now Département de Vaucluse). The author describes, at great length, the mode of cultivation of Marena madder, grown in the Derbent (a portion of Russia, formerly a Persian province). The soil of that district is a rich alluvial clay, containing a large quantity of calcareous matters and humus; the madder seed is sown in the November, and the roots are collected in the fourth following spring (April). The roots are first placed in well-aired sheds, and next submitted to a peculiar process of steaming, by being placed in what may be termed tanks dug in the soil, 2 metres deep and 1 wide. These tanks are first heated, by means of the combustion of wood, to such an extent, that the sides become red-hot; when this is effected, the madder-roots, previously watered, are thrown upon the smouldering embers; and when the hole is filled, covered over with coarse woollen cloths, and left in the hot tanks for six hours; the roots are then removed, and next dried in the sun. A great portion of this paper is, by the acknowledgment of its author, who has been in Russia, abstracted from the works of MM. Persoz, Girardin, Schützenberger, and others.

*Journal für Gasbeleuchtung* (two numbers), May and June, 1870.

These numbers contain the following papers relating to chemico-physical subjects and collateral sciences:—

**Philipp's Carboxygen Illumination.**—O. Kellner.—The author describes, at great length, the process of the manufacture of oxygen from protochloride of copper, obtained by heating the chloride of that metal, which, in order to prevent its caking together, is mixed with 33 per cent of broken pottery-ware. When submitted to heat, chlorine is first given off, according to the formula—



When the protochloride is exposed to moistened cold air, an equivalent of oxygen is taken up for that of chlorine previously given off, yielding—



This taking up of oxygen goes on very rapidly, even with large masses, but becomes almost instantaneous in the presence of steam and air at 200°; while, at 400°, the oxygen taken up is given off again, and only requires cooling for the purpose of condensing the watery vapour it carries; after condensation, it is at once collected in gasholders. The cost price of the protochloride of copper is, in Germany, about 1s. 6d. per kilo.; 50 kilos. of this material yield from 1.3 to 1.5 cubic metres of oxygen gas.

**Photometrical Studies.**—Dr. F. Rüdorff.—Third and concluding portion of this lengthy paper.

**Communications from the Committee of the Society of German Gas Engineers in reference to the Supply of Water to Towns.**—This very interesting and lengthy memoir is divided into the following sections:—Waterworks of Hamburg; introduction and history; sources of supply; pumping machinery; canalisation and distribution of mains; regulations for the supply and use of the water; waterworks of Altona; waterworks of Vienna; waterworks of Schweidnitz (Silesia, Prussia).

**Report of the General Annual Meeting of the German Gas Engineers at Hamburg, May 23—26 last.**—This lengthy memoir contains nothing but what directly relates to the peculiar subjects discussed at such meetings. Chemical subjects have not been treated.

*Revue Universelle des Mines, de la Métallurgie, et des Travaux Publics de Belgique*, No. 2, 1870.

This number contains the following original papers and memoirs:—

**Agglomeration of Fuel.**—A. Habets.—The second portion of this very lengthy essay, illustrated by engravings, and chiefly treating of the best means of usefully applying the large quantity of small coal which becomes wasted at and near collieries and coal-pits.



**Manufacture of Cast-Steel by means of the Refining of Pig-Iron with what is termed Intermolecular Combustion.**—S. Jordan.—This lengthy memoir contains the following chapters:—General review; combustion of iron, of manganese, of carbon, of silicon; refining by means of atmospheric air; refining by means of steam; refining by means of oxygen.

**Researches on the Permanent Motion of Gases through Pipes and Tubes.**—Dr. Grashof.—An algebraico-physical essay.

*Annales des Mines*, No. 3, 1870.

This number contains the following original papers and memoirs relating to physico-chemical and allied sciences:—

**Geological Notes on Oceania, the Islands of Tahiti and Rapa.**—J. Garnier.—A very lengthy and valuable monograph on the geology of these far-distant countries.

**Process of Desilvering Lead, as Executed at the Works of MM. Herbst, Brothers, at Call (Eifel, Prussia).**—R. Zeiller and A. Henry.—The authors describe, at length, a peculiar process of desilvering lead by the aid of zinc, especially suited for the conditions of the works where these manipulations are carried out. The authors state that the process is effective and cheap in every respect, labour included.

**Accident in a Beet-Root Sugar-Works at Cruzin (Nord, France).**—J. Callon.—It appears that one of the steam-boilers of the beet-root sugar-works of MM. Miroux and Co., at Cruzin, after having been out of use for several months, had to be cleaned before being put in operation again. The water contained in the boiler at the time of stopping its work had been let off by the usual means; but, from some cause or other, the boiler and brickwork of the furnace (as found after the accident to be mentioned) had become slowly inclined backward, and, as a consequence thereof, a portion of the water was left; nothing, however, indicated, on opening of the man-hole, that the air in the boiler was greatly vitiated and unfit to support life. One of the workmen, who entered the empty boiler for the purpose of cleaning it, was, on approaching the end of it where the water had remained stagnant, almost instantly killed by the putrid miasmas given off; and the man who dragged the almost lifeless body out of its dangerous position was saved with difficulty. The author of this paper, who is a member of the Central Committee for the Surveillance of Steam-Engines, states that no other case of such an accident having occurred is on record, but that the cause is undoubtedly due to the vitiated air in the confined space, the vitiation being caused by the putrefaction of organic matters collected in the water left in the boiler.

**Mineral Resources of the Ariège.**—(Third part.)—M. Mussy.—The concluding portion of this lengthy monograph. This portion includes the mineral waters, with analyses, but their number is too large for specific quotation here.

*Bayerisches Industrie und Gewerbe Blatt*, May, 1870.

This number contains the following original papers relating to chemistry and collateral sciences:—

**Depositing Zinc upon Copper or Brass, in the Wet Way.**—Dr. R. Böttger.—The author first prepares finely-divided zinc, by pouring the molten metal in a previously strongly heated iron mortar, and stirring until nearly cold. The pulverulent zinc thus obtained is placed in a porcelain vessel, and to it is added a concentrated aqueous solution of sal-ammoniac. This mixture is heated to boiling; and the copper or brass objects to be coated with zinc (but previously well-cleaned, and, best, even with an acid) are then placed in the liquid, wherein they become coated with a brilliantly-white adhering layer of zinc.

**Chemical Investigation of a Bohemian Lager Beer.**—A. Vogel.—The sample analysed had been kept for two-and-a-half years in casks; the liquor had a deep brown colour; its taste was pleasant, but not bitter. One litre of this beer contained—Water, 878.4 c.c.; extract, and other following substances, in grms., 70.5; alcohol, 48.8; carbonic acid, 2.3; sugar, 5.0; phosphoric acid, 0.58; nitrogen, 0.46; ash, 2.4.

**Paper and Millboard from Peat.**—M. Oppermann.—The author states that M. Halbach, paper maker at Leer (Hanover), has succeeded in employing, along with straw, the fibrous matters met with in peat bogs for the manufacture of coarse paper and millboard.

*Bibliothèque Universelle et Revue Suisse.*—*Archives des Sciences Physiques et Naturelles*, July 15, 1870.

This number contains the following original papers relating to physico-chemical and collateral sciences:—

**Researches on the Magnetic Rotatory Polarisation of Liquids.**—A. de la Rive.—This very lengthy memoir is divided into the following paragraphs:—Description of apparatus and method of experimenting; determination of the specific magneto-rotatory power of some liquids—viz., alcohol, sulphide of carbon, sulphuric acid, sulphurous acid; influence of the temperature upon the magneto-rotatory polarisation of liquids—viz., alcohol, iodide of ethyl, amylic alcohol, distilled water, and sulphuric acid, (HOSO<sub>3</sub>); determination of the magneto-rotatory power of a mixture of two liquids; determination of the magneto-rotatory powers of some isomeric liquids—viz., acetate of amyl, valerate of ethyl, butyrate of isopropyl, amylic alcohol, hydrate of amylene; conclusions drawn from the experiments.

**Cretaceous Formations met with in the Exterior Alps on Each Side of Lake Léman.**—V. Gilliéron.

**Radical of Phthalic Acid.**—E. Ador.—The author describes, at great length, the complicated reactions by which he obtained phthalyl, a crystalline compound, insoluble in water. Alcohol, ether, chloroform, acetone, sulphide of carbon, acetic acid, and carburets of hydrogen dissolve only a very small quantity of phthalyl; its best solvent is boiling phenic acid. Phthalyl is sublimable at a high temperature, and is strongly acted upon by bromine and sulphuric acid. The formula of phthalyl is C<sub>8</sub>H<sub>4</sub>O<sub>2</sub>. Concentrated nitric acid converts phthalyl, at boiling heat, into diphtalic acid, C<sub>16</sub>H<sub>10</sub>O<sub>6</sub>, a white-coloured crystalline substance, somewhat soluble in water, fusing at 259°, and yielding then anhydrous phthalic acid.

*Les Mondes*, August 11, 1870.

**Pindray's Smoke-Consuming Furnace.**—M. Tilloy.—The author, proprietor of a large factory, states that he has had constructed a 70-H.P. steam-boiler, with furnace and flue arrangement according to M. Pindray's plan, and that he has every reason to be highly satisfied with this arrangement, whereby he daily saves 15 hectolitres of coals; emits no smoke or combustible gases from the chimney; keeps up steam at full pressure, even when clearing the fires; whilst with the combustion at its greatest activity, the bottom of the fire-bars is hardly hot. We do not know what M. Pindray's arrangement really consists in, but we can readily affirm, by experience, that such results may be arrived at, even with multitubular marine boilers.

**International Scientific Relations.**—Dr. A. Boué.—The author calls attention to the fact, that a great many scientific publications of the northern and easterly parts of Europe remain, unfortunately, almost unknown, save in the countries where the languages (Swedish, Danish, Finnish, Lithuanian, Russian, Czech, Slavonic, Magyar, Polish, Neo-Greek, and Roumanian, to which may be added Dutch) in which they are published are vernacular. The author proposes that it would be an advantage if, for each of these publications, either a full translation or an abstract of the papers were simultaneously published in French, English, or German.

**Use of Iron in Homer's Period.**—F. De Hauer.—This paper, chiefly of historical interest, contains, among other interesting facts, the opinion, defended, that the oldest iron ever in use was of meteoric origin, and therefore contained nickel. That copper and bronze were far earlier known and used than iron or steel, which latter, however, have been well-known to all purely Germanic races probably before these metals were known in some more easterly countries.

**Aspect of the Environs and Basin of Paris shortly before and during the First Apparition of Man.**—E. Robert.—An archæo-geological paper of value, but too lengthy and too special to admit of any useful abstraction.

*Cosmos*, August 13, 1870.

**Composition of Rain-Water.**—Dr. G. Tissandier.—The author has analysed some rain-water fallen at Paris on the 1st and 8th of July last. The portion (only some drops purposely collected on watch-glasses) which fell on the first-named date contained no less than 4.68 per cent of solid matter; microscopical observation proved the existence therein of *débris* of woven tissues, threads, coal-dust, starch granules, sand, and *débris* of wood. On being evaporated, a drop weighing 0.032 grm., and then seen under the microscope, was proved to contain crystals of nitrate of ammonia and crystals of common salt. On the last-named date, a litre of water was collected on the top of a roof in Paris; this water, on being analysed, yielded a total solid dry residue of 0.0658 grm., containing—Insoluble mineral matters, 0.0108 grm.; insoluble organic matter, 0.0340 grm.; soluble salts, 0.0210. This rain-water was found to contain 0.020 grm. of nitrate of ammonia; and, since this salt contains 35 per cent of nitrogen, it follows that the 10 m.m. of rainfall of the 8th of July carried down 70 grms. of nitrogen per hectare, besides the organic matter.

**Ancient Glaciers of the Auvergne.**—J. Marcou.—A lengthy geological paper. The author comes to the conclusion that glaciers have existed in the Auvergne before the volcano of the Puy de Dôme and Mont-Dore were uplifted.

## TO CORRESPONDENTS.

\*\* The STUDENT'S NUMBER of the CHEMICAL NEWS will be published on Friday, September 9th. Gentlemen holding official positions in the Universities, Medical Schools, &c., of the United Kingdom, where Chemistry and Physical Science form a part of the Education, who have not yet forwarded the necessary information to our office for publication in that number, will confer a favour by sending it with the least possible delay.

*A Reader, W. R., and others.*—Professor Storer's work on Analysis is not yet out; it will be published in the United States. We do not know the price at present, but will give full particulars as soon as possible.

*T. Dearden.*—The preparation of precipitated colours is treated in Gentile's "Lehrbuch der Farbenfabrikation," and also in Cooley's "Cyclopædia of Practical Receipts."

*Dr. Stenhouse, F.R.S., C. Tomlinson, F.R.S., and A. Liversidge*, are thanked for their communications.



# THE CHEMICAL NEWS.

VOL. XXII. No. 562.

## EXAMPLES FOR PRACTICE IN QUANTITATIVE CHEMICAL ANALYSIS.\*

By FRANK H. STORER,  
Professor in Massachusetts Institute of Technology.

(Continued from p. 99).

### EXPERIMENT III.—Estimation of Chlorine in Chloride of Sodium.

HEAT a quantity of pure powdered chloride of sodium in a porcelain crucible, in order to expel hygroscopic moisture. Weigh out about 4 grms. of the dry powder, place it in a glass flask of about a litre capacity, and dissolve in 200—250 c.c. of water. Heat the solution moderately, add to it a quantity of nitrate of silver solution, cork the flask and shake it strongly. As soon as the chloride of silver has become curdy and coherent, and the liquid clear, add to the latter a drop more nitrate of silver. If a fresh precipitate is produced, add as much more nitrate of silver as may seem fit, again heat and shake the liquor, and repeat these operations until the addition of a drop of nitrate of silver ceases to produce any precipitate. Wash from the cork any particles of chloride of silver which may adhere to it, fill the flask completely with water, close its mouth with a small glass plate, invert it in an evaporating dish (a No. V. Berlin dish will do) two-thirds full of water, and remove the glass plate, shake the flask gently until all the chloride of silver has fallen from it into the dish, then remove the flask from the dish by a sudden jerk, in such manner that none of the chloride of silver shall be thrown from the dish. Finally, transfer the precipitate from the dish to a 6-inch filter, and wash it with hot water, until the filtrate ceases to leave any residue when evaporated on glass. Dry the precipitate, transfer it to a porcelain crucible, taking care to leave as little of it as possible upon the paper. Burn the filter on the cover of the crucible, and afterward heat the precipitate in the crucible until the mass begins to fuse upon its edges.

Four grms. of chloride of sodium gave 9.7825 grms. of chloride of silver (=2.4192 grms. chlorine), or 60.48 per cent. Theory required 60.66 per cent.

(To be continued).

## ON THE ACTION OF NUCLEI.

By CHARLES TOMLINSON, F.R.S.

THERE are a few points in the two notes by Mr. Liversidge that require notice.

1. *Do nuclei act when wet?*—This point was first noticed by Ziz, of Mayence, in 1809.† He found bits of iron wire, flint, glass, small coins, &c., caused supersaturated solutions of sulphate of soda to crystallise; but, if previously wetted, these bodies become inactive. In noticing these experiments a few years ago,‡ I attempted to define the conditions under which dry active nuclei may be rendered inactive while still dry; and I endeavoured to show that, “if previously wetted with water, they are not wetted by the solution when thrown into it, and, consequently, cannot act as nuclei, because the solution does not really come in contact with them.” It will be found,

however, that the statement, *nuclei do not act when wet*, is far too general in its terms. All that can be said is that they sometimes, or often, do not act, or they do not act at once, for it may happen that wet unclean nuclei do act after some hours; whereas, if such nuclei be boiled up with the solution, and so made clean, they never act, though the solution be kept for months and be shaken every day. Löwel also noticed\* that rods of glass, &c., kept in cold water, become *partially*, or wholly, inactive. Such rods, partly immersed in sulphuric acid or caustic alkali, and dried out of contact with air, are wholly inactive to the extent of the immersion, as may be shown by plunging them into soda-water, boiling water, or a supersaturated solution of Glauber's salt. There will be no liberation of gas, or vapour, or salt, but, on inserting the unclean end, it will act as a powerful nucleus.

2. *What is meant by chemically clean?*—Having proved, I think, that bodies are *nuclear* or *non-nuclear*, according as they are not, or are, chemically clean, a definition of the term “chemically clean” was required. It was justly urged that a definition which excludes oils and fatty bodies could not be accepted, since these may be as clean as a catharised glass rod. After much experimental research, I arrived at the following:—“A substance is chemically clean whose *surface* is free from any substance foreign to its own composition.”

This definition is so far guarded, that it refers to *surface* only. A glass rod, for example, is regarded as chemically clean, even though a particle of carbon or oxide of iron be enclosed and shut off within it; but not so if that particle reach, and form part of, the surface itself. Such a particle, if porous, acts as a powerful nucleus in separating vapour from a boiling liquid, and it also may act as a centre of crystallisation in a solution. So, also, a phial may be chemically clean as to surface, even though it enclose nuclear particles; and “a mixture of wax, oil, soot, dust from the floor, sodic sulphate, soap, &c., melted together on a glass rod,” may be a clean surface of wax, enclosing unclean particles.

3. *Can the finger be made chemically clean?* In a paper on “Some Effects of a Chemically Clean Surface,”† I refer to the delicate test of chemical purity afforded by the motions of camphor on water. Camphor was rotating briskly in the surface of water, in four glasses, A, B, C, D, when I put my finger into A, my tongue into B, the glass C was emptied and filled up with water from a jug that was in domestic use, while D was emptied, wiped with a glass cloth in ordinary use, and filled up with clean water. Fresh fragments of camphor were scraped upon all four glasses, and they were motionless on A, C, and D, thus showing that the surface of the water in each of these cases had contracted a nuclear film. In the same paper it is shown that other phenomena which depend for their action on the state of chemical purity are at once arrested “if the finger or other chemically unclean body be made to touch the water.”

In a popular account of this paper given in one of the journals, I am made to say “that the finger cannot possibly be made chemically clean.” This statement was met by an experiment by Prof. Van der Mensbrugghe.‡ He admits that the motions of the camphor are instantly arrested if the water be touched with the finger, and adds, “Ces effets sont certainement dus à la couche graisseuse adhérente presque toujours aux doigts; car, si l'on a préalablement soin de se laver les mains avec de l'alcool, puis avec de l'eau distillée, le contact de la surface liquide avec le doigt n'arrete plus les mouvemens du camphre.”

What I really did say, was, that the finger cannot be made chemically clean in the sense that a glass rod is so cleaned;|| since the finger, however protected from external influences, generates, of itself, a nuclear action. I

\* Communicated by the Author. From the Massachusetts Teacher.

† Schweigger, *Journal für Chemie und Physik*, xv., 160.

‡ *Philosophical Magazine* for August, 1867.

\* *Annales de Chimie et de Physique* for 1850.

† *Phil. Mag.* for October, 1868.

‡ *Memoires Couronnés de l'Académie Royale des Sciences de Belgique* for 1869, Tom. xxxiv.

|| *Journal of the Chemical Society*, xxii., 130.



performed an experiment with the view to determine, if possible, how long the finger, being made chemically clean, would remain so. The finger was first thoroughly washed in a solution of soap, then in alcohol, and, lastly, under a stream of water, and so dipped into water, on the surface of which the camphor fragments were spinning briskly. The finger was retained under the surface of the water, and slid along about an inch in length of the surface of the glass below the water. In less than two minutes the camphor fragments were brought to rest, and they did not recover their activity.

I have, on several occasions, put the clean finger into highly supersaturated solutions of sodic acetate with no effect, until a smear was produced by drawing the finger with pressure against the side of the glass, when the solution immediately became solid.

In experiments of this kind the results may vary according as the skin is naturally moist or dry, soft or hard; just as it is said to happen occasionally when a chain of hands is formed for the passage of an electric shock, the skin of one pair of hands is so dry that it acts as an insulator for a weak charge. I think it likely also that, by passing the finger through flame, it might not arrest the camphor motions when first put into the water, any more than act as a nucleus when just dipped into a supersaturated solution of Glauber's salt.

4. *Is an iridescent film ever inactive?* I need not repeat what has been already said respecting the limitations to my definition of chemical cleanliness, namely, that oils and fatty bodies, if clean, are not nuclear in the lenticular state, but are so in the condition of films. Mr. Liveridge, if I understand him rightly, has noticed iridescent films of oil, &c., on the surface of a supersaturated solution of Glauber's salt, that did not act as nuclei. This does not agree with my experience, but I may remark that in researches on the action of nuclei some attention must be paid to temperature. Solutions vary so much in sensitiveness as the temperature rises or falls, that experiments that succeed very well in winter may fail altogether in summer. This is especially the case with weak solutions, which may be supersaturated in cold weather but are only saturated in warm; and, of course, when saturated only, the observations as to the action of nuclei fail to apply.

A striking example of this kind is afforded in a paper by M. E. Lefebvre\* on the "Supersaturation of Calcic Chloride," in which a large number of bodies are tried as to their nuclear action, and arranged into classes according as they do or do not act; whereas if the solution of the strength indicated be sufficiently reduced in temperature any one of the bodies which are said to be inactive may become active. The films formed by oils on the surface of highly supersaturated solutions of sodic sulphate produce, in cold weather, very fine prismatic plates of the 10-atom salt with dihedral summits; whereas, the same film acting on a solution of the same strength in hot weather produces much smaller crystals, far less perfectly formed. A strong solution of calcic chloride may be quite passive to the action of nuclei in hot weather; but if the vessel be put into a freezing mixture it becomes highly sensitive.

Highgate, N., August 27th, 1870.

## THE NIIN OF YUCATAN.†

A COMMUNICATION from Dr. Arthur Schott, late of the Scientific Commission of Yucatan, furnishes some descriptive statements concerning an insect, and the nature and uses of a grease-like or wax-like product, with the result of a chemical examination of its properties.

Among the numerous interesting natural productions of Yucatan, not the least remarkable is the niin (pronounced *neen*), the knowledge of which, and of its technical application, has survived the national independence of the gifted Maya race. The niin is the grease of an insect bearing the same generic name. The niin may be considered akin to the cochineal, also the product of a similar insect; but they differ essentially in their nature, one serving as a well-known dye, while the other finds its application as a drying oil.

The nature of the niin will be clearly understood by the annexed scientific analysis, made by Mr. V. G. Bloede, analytical chemist, of New York. The matter examined by that gentleman consisted of a small quantity which Dr. Schott brought some time before from the city of Merida, Yucatan.

The analysis is as follows:—

The Yucatan niin is a yellowish-brown, fatty mass, having a peculiar oily odour. In its general properties it seems closely allied to hog's lard or suet. It is neutral to test-paper, neither presenting acid nor alkaline reaction, though, when exposed to the air, it acquires a very faint tendency to manifest the former. Its melting point is about 120° F., though, when once melted, it still remains in a semi-fluid state with the temperature as low as 80° or 85° F. When cooled to 10° F., it becomes hard and brittle, like suet. At ordinary temperatures, that is, about 60° F., it is of a thick, pasty consistency, like ordinary lard. Its specific gravity at 60° F. is about 0.92.

*Its Solvents.*—In regard to solvents, the niin presents the same general properties as any ordinary animal fat. It is not soluble in either hot or cold alcohol, even after extended maceration. It is freely soluble in both hot and cold ether, with which it forms a yellow, oily liquid. It is very soluble in turpentine, with which it forms an oily liquid possessing peculiarly valuable properties for mixing delicate oil colours, of which I shall speak hereafter. It dissolves freely in benzine; chloroform, also, is among its best solvents.

*Chemical Properties.*—The niin, in its classification in organic chemistry, must undoubtedly be ranked among the drying oils, though its absorption of oxygen takes place rather more slowly than with many other oils. Nor is this slowness in drying accelerated to any extent by boiling it with oxide of lead. It is the first, or nearly the first, example we have of a thoroughly drying animal butter or solid fat. Like some others of the animal fats, it contains a distinct volatile acid peculiar to itself. As, for instance, butter contains butyric and caproic acid; goat's fat, hircic acid; so the niin contains an acid of a peculiar, pungent smell, which might be aptly termed niinic acid. Its chemical composition differs little from ordinary animal fats. Like others, it contains a fluid oil—oleine—and a solid containing stearic, margaric, and other fatty acids. A portion of the acids may be obtained by dissolving the niin in turpentine or ether. The oily portions pass into solution, while a solid precipitates, consisting of the acids indicated, which may be separated from the fluid by filtration.

*Saponification.*—A peculiarity of the niin seems to be its difficult saponification. The strongest ammonia procurable has no saponifying action on it. Even if the fat be digested in ammonia for several days, no liniment is formed, but a marked transition from yellow to red seems to be the only change produced. This change of colour depends merely on the action of ammonia on the colouring matter of the niin, which, like the yellow turmeric (*Curcuma longa*), changes to red as it assumes an alkaline reaction.

With potash, too, it saponifies but slowly and imperfectly, and a concentrated lye is necessary. With soda it forms a soap only after extended boiling with a strong lye. It is only after several hours' boiling with oxide of lead that it forms the so-called "lead soap," and then the product is very imperfect. From these facts we can at once deduce that the niin cannot be considered

\* *Comptes Rendus*, March 28, 1870.

† From the Report of the United States Commissioners of Agriculture.



a "good saponifying fat," but belongs to the "drying oils."

*Effects of High Heat.*—When the niin is melted in a porcelain dish, and the resulting oil exposed to a continued and high heat (between 250° and 350° F.) for an hour, or until a considerable portion of it has evaporated, the residue in the dish will then be found to have assumed a tough, flexible, varnish-like condition—a gelatinous mass no longer soluble in turpentine, or affected by heat or cold, at least to a great extent.

If a piece of this gelatinised niin is placed on a piece of porcelain, moistened with turpentine, and ignited, another remarkable change takes place; for, if the plate is slightly inclined as the mass burns, a thick, yellow, resinous oil or gum flows from it, which possesses most remarkable adhesiveness, closely resembling a thick solution of india-rubber, but which does not dry, retaining its half-fluid consistency for several days. This is a most singular change, and one that is worthy of further investigation.

*Change of Air.*—When the turpentine solution of the niin is exposed to the air in thin strata for a few days, it acquires the properties of a resinous varnish; in fact, the change is so complete, that when some of the solution is poured on a piece of glass it dries almost equal to fine shellac varnish. This change is due to the absorption of oxygen. If further developed, this property will undoubtedly make the niin of the greatest commercial value. The film of varnish is very elastic, and, at the same time, hard, which renders it superior to some of the other gums. An alcoholic solution can also be formed, but this is more difficult.

*Suggestions as to Use.*—The extreme oiliness of the niin will undoubtedly make it very valuable for various purposes in the arts; and its "drying" solution in turpentine has no equal for mixing fine colours for artists. This turpentine solution of the niin produces a remarkable brightness in the colours prepared with it, and they dry rapidly. But the chief value of the niin, which will give it commercial importance, is its property of forming a resinous varnish when treated as before described, rendering it superior to shellac for some purposes. Another valuable application of the niin could be found in the manufacture of waterproof fabrics. A piece of the most porous Swedish filtering paper, saturated with a solution of the niin diluted in turpentine, will not allow a drop of water to pass through, even after standing in it for days. An excellent way of water-proofing would be to saturate the article with melted niin, and then expose it in an oven to considerable heat until the grease gelatinises. By these means the niin becomes insoluble, not only in water, but also in most of its solvents. If the niin can be obtained, as Dr. Schott says, in "unlimited" quantities, it will, doubtless, in time become of great commercial value.—*Scientific American.*

## NOTE ON ITACOLUMNNITE.

By Professor A. M. EDWARDS.

To those accustomed to the use of the microscope it is not a matter of surprise that persons who do not commonly employ that instrument in research should make very serious mistakes in interpreting what they think they see by means of it, the more especially when high powers of magnification are made use of. The delicacy of manipulation necessary to work with the microscope at all satisfactorily, and the education of the eye required for the proper seeing by means of it, are not generally understood, so that those who are not skilled microscopists are extremely liable to be led into error. What

I am inclined to consider a case of this kind has lately been brought to my attention, and I am persuaded to make a note of it, the more for the purpose of correcting a grave error in investigation, and one which is, strange to say, readily demonstrated to be an error.

In 1867 (*American Journal of Science*, vol. xliv.), Dr. C. Wetherill published a well-written and seemingly-exhaustive paper, setting forth some "Experiments on Itacolumnnite, with the Explanation of its Flexibility, and its Relation to the Formation of the Diamond." In attempting to elucidate the flexibility of this rock he has made use of the microscope, and, in fact, mainly draws his conclusions from the revelations which he supposes that instrument makes. Some specimens of itacolumnnite, varying in tint from almost pure white to a rusty red tint, and in texture from finely granular to coarse and distinctly laminated, having come into my hands, I have been enabled to examine into this point of structure and attendant flexibility, which I have done with some care.

It is well known that itacolumnnite is the accompaniment, and often the matrix, of the diamond; hence the interest which attaches to its peculiarities, as it would seem in some way to be connected with the occurrence or formation of that gem. Detecting dark coloured grains in it, Dr. Wetherill considers them to be black diamonds, and doubtless he is correct in his supposition, but with this portion of his paper I do not desire to deal at the present time. It is with regard to the structure of the sandstone, whereby it becomes flexible to the remarkable degree so evident when thin slabs are examined. The stone is plainly laminated, and has clearly been thrown down beneath water, it being readily cleavable into more or less distinctly marked laminæ.

Almost universally the flexibility is attributed to the presence of mica, but the brighter-coloured specimens which I have examined contain no mica, and yet possess the property of being readily bent to a very marked degree. Even in the red-tinted specimens there are large portions in which no mica is found. Dr. Wetherill says, that by examining the itacolumnnite by means of the microscope, he has been enabled to ascertain that the "flexibility is due to *small and innumerable ball-and-socket joints* which exist throughout the mass of the stone very uniformly. Each joint permits a slight movement which is always greater in one direction." Now, I must say that, though I have come to the investigation prepared with considerable faith, yet, after many careful examinations, I was never able to force my imagination to the extent of getting it to show me anything resembling ball-and-socket joints. The examination need not always be made of the opaque sandstone, but portions can be roughly crushed and mounted in Canada balsam, so that light may be transmitted through them, and the mode of their interlocking plainly made evident. The fact is that the rock is made up of small, broken, irregular masses of transparent sand, which evidently have not been carried any great distance by water, as their sharp edges have not been at all abraded, but, on the contrary, remain, but they have evidently been broken off from a rock which had a conchoidal fracture, they being little plates of extremely irregular outline. Thus, when they settled in the liquid in which we can suppose them to be thrown down, they naturally, for the most part, distributed themselves with their greatest axes in the same direction, and hence the lamination and cleavage of the rock itself. We can readily understand that in such a rock, if the particles were not strongly held together, that they would possess a certain amount of motion one over the other, and this motion would be most marked in a direction at right angles to the lamination, which is the case. But, also, such a rock would not be elastic, only flexible, and gradually, after several times bending, be broken. Such is exactly the case with itacolumnnite. In fact, any one possessing a microscope and a fragment of this rock can readily verify my observations, and demonstrate that Dr. Wetherill's proposed name of articulite

\* From the *Proceedings of the Lyceum of Natural History, New York.*



is inappropriate for itacolumbite. In conclusion, I would mention that grains of the crushed rock, when put up in Canada balsam, become very beautiful objects for examination by means of the micro-polariscope, exhibiting a gorgeous display of colours when the interposing selenite film is used.

## POTASH SALTS FROM SEA-WATER—BALARD'S PROCESS.\*

By J. LAWRENCE SMITH.

THIS is another mineral source of potash salts, and it was first devised by Balard some sixteen or eighteen years ago, and has been carried on successfully for many years, but is now seriously interfered with by the supply from the new source of potash in the deposits of potash compounds called "Sylvine" and "carnallite," found occurring in the rock-salt mines of Stassfurt.

By Balard's method the potash salts are obtained in treating the mother-liquor of sea-water salt works, which we may regard as essentially composed of chloride of potassium, sodium and magnesium, and sulphate of magnesia. The object in view is to bring all the sulphuric acid into combination with the soda, and then to obtain, by separate crystallisations, the chloride of sodium, the chloride of potassium, and the chloride of magnesium; the last, being of but little practical value, is allowed to run to waste. The means used to accomplish the results are altogether physical, namely, the abstraction of heat by natural or artificial means. It is based on Scheele's observation, made a great number of years ago, that if a mixture of chloride of sodium and sulphate of magnesia in solution be reduced below freezing point, a double decomposition takes place, and crystals of hydrated sulphate of soda are formed, and chloride of magnesium remains in solution. The separation of the mixed chlorides is made by boiling and cooling the mother-water freed from the sulphate of soda. The original process of Balard was much improved by M. Merle, who employs an artificial cooling process. The following is a detailed description of his process, as communicated by him to the chemical reporters of the London Exposition in 1862.

The process may be shortly defined to consist in the further concentration of concentrated sea-water by exposure to a low temperature, artificially produced. The degree of concentration requisite to fit sea-water for treatment by this process is 1.24 sp. gr., (28° B.) at which point of concentration sea-water deposits about four-fifths of the culinary salt contained in it.

This degree of concentration is obtained by the ordinary process of evaporation on the ground as practised in the manufacture of common salt, of which the ample crop obtained repays this preliminary operation. The mother-liquor which remains is the raw material of the new process. It is stored in large covered tanks, and from this point forward it undergoes no further exposure to dilution by rain, or to absorption by the soil. It is withdrawn from the ordinary operations of the salt gardens, from which M. Merle borrows the one first step—concentration of 1.24 sp. gr. (28° B.) As, however, this degree of concentration is found to be a little beyond the density most favourable to the next stage of the operation, ten per cent of pure water is added to the liquor in the tanks. Thus prepared, the concentrated sea-water is next passed through refrigerating vessels, which are constructed on Mr. Carré's principle, and which cool it to 18° C. This artificial refrigerator causes the desired double decomposition to take place between the sulphate of magnesia and chloride of sodium, sulphate of soda being deposited by the water as it passes through the machine, and chloride of magnesium being carried away in solution.

The process is continuous. The water passes constantly in at one end of the apparatus and out at the other, and the deposited sulphate of soda is continuously withdrawn from the apparatus by a chain of buckets. This salt is speedily freed from mother-liquor by a centrifugal hydro-extractor, and is finally dried in a reverberatory furnace. The utility of the above-mentioned dilution of the tank liquors is now made manifest. If cooled down while at their original density (28° B.) they would let fall much hydrated chloride of sodium, along with the sulphate of soda, to the detriment of its purity and value. But in consequence of the dilution the culinary salt remains dissolved, together with potassic and magnesian chlorides, in the mother-liquor which flows away from the machine.

This mother-liquor has now to be treated for the recovery of the salts it holds dissolved. For the recovery of the culinary salts the mother-liquor is made to flow from the cooling machine directly into boilers like those used in refining rock salt. In these it is boiled down to 1.331 sp. gr. (36° B.), by which time it has deposited nearly the whole of its common salt in a fine powder, which, when dried in a centrifugal machine, equals for purity the best English refined salt. It only remains now to recover the chloride of potassium still dissolved in the hot liquor, which, for this purpose, is poured forth to cool in extensive shallow coolers formed of concrete. Here it soon deposits the whole of its potash as a double chloride of potassium and magnesium. This deposit (a kind of artificial carnallite) is collected, and the magnesian chloride is eliminated therefrom by adding to the mixed mass half its weight of fresh water. This dissolves the whole of the more soluble magnesian chloride, but only one-fourth of the potassic chloride. Three-fourths of the potash are thus obtained as a chloride, containing only one-tenth of extraneous saline matter; the remaining fourth, dissolved with the magnesian chloride in the wash-water, is returned to the boilers.

This capital process works with the utmost ease and regularity. The energetic action of the artificially lowered temperature not only dispenses with the successive eliminations which form the basis of M. Balard's method, but causes the double decomposition to take place with such intensity that the mother-liquors retain but a small proportion of sulphate of magnesia, and lend themselves with ease to the further treatment for obtaining the potash salts. Thus, when the liquid is heated in the boilers, nearly the whole of the chloride of sodium separates without carrying down with it any potash; and when the double chloride is deposited by the subsequent cooling, no potash is left in the waste liquor. The whole of the potash is thus precipitated as double chloride; and this salt being very pure, nothing more is required, in order to obtain separately the chloride of potassium, than to wash out the chloride of magnesium with cold water, and to dry the residue in the centrifugal machine. A very remarkable feature of M. Merle's process is the great facility with which the chloride of sodium is obtained in a finely divided state by ebullition in the boilers. If the liquor of 1.24 sp. gr. (28° B.) were boiled down without previous elimination of the sulphate of magnesia by the above-mentioned cooling process, crusts would form on the bottom of the boiler to such an extent as to hinder the operation greatly, if not entirely to stop it. But the double decomposition which takes place under the influence of cold, by depriving the liquor of sulphate of magnesia, and rendering it rich in chloride of magnesium, changes these conditions. Indeed, the liquor thus treated may not only be boiled down without the formation of the strongly adhering earthy deposits which would otherwise appear, but it does not even produce the slight crusts which form during the refining of rock salt; so that the preparation of the refined salt is carried on under very favourable conditions. Ease and regularity are not, however the only characteristics of this process. It is remarkable, also, for the large quantity of saline products which it is capable of yielding. In fact, the salt-work

\* From the "Progress and Condition of Several Departments of Industrial Chemistry."



operation being limited to the production of a liquor of 1.24 sp. gr. (28° B.) on the ground, the loss arising from the permeability of the soil is quite insignificant, and not to be compared with the serious waste which results from this cause when the treatment of the liquor in the salt gardens is continued to much higher degrees of concentration, according to the earlier practice. In point of fact, the first stage of the treatment in the salt works, according to the original method, becomes the last stage in the improved plan. The saline water of 1.24 sp. gr. (28° B.) once transferred to the large tanks remains, during all further stages of the process, in metallic vessels; and, as the subsequent operations are conducted without loss, an amount of product is obtained which, when large evaporating surfaces are employed, may become enormous. A cubic metre of liquor at 28° B., which, if no loss occurred, would correspond to 25 cubic metres of seawater, but which, in consequence of the loss occasioned by infiltration, is equivalent to 75 cubic metres of seawater, yields, when treated as above described, 40 kilogrammes of anhydrous sulphate of soda, 120 kilogrammes refined culinary salts, and 10 kilogrammes of chloride of potassium.

### LIQUEFACTION OF CYANOGEN FOR LECTURE EXPERIMENTS.

By Dr. A. W. HOFMANN, F.R.S.

TAKE a piece of combustion-tube about 30 centimetres long, and sealed at one end; at the open end, fix, by means of sealing-wax, a brass cap fitted with a well made brass tap, furnished, in the axial direction of the tube, with a corrugated hose socket. In order to remove the air from this apparatus, a glass tube of narrow diameter is made to pass through the opening of the stopcock into the combustion tube, and carried down to the sealed end thereof; cyanogen gas is conducted through this narrow tube into the apparatus until the gas issuing from the brass socket exhibits, on being ignited, the genuine characteristic cyanogen flame; the narrow glass tube is then withdrawn, and the stopcock shut. The cyanogen gas condensation apparatus consists of two strong flasks, each of a litre capacity, and furnished, at or near the bottom, with tubulatures; these flasks are connected together by means of strongly-made india-rubber tubing enclosed in a stout canvass hose, and 1½ metres in length. One of these flasks is placed somewhat higher than the other, in such a manner that, if the lower is filled with mercury up to the neck, this metal rises in the other flask above the lateral tubulature. In the neck of the flask filled with mercury (lower flask), a perforated cork, carrying a glass tube bent twice at right angles, is inserted, and the cork is fastened to the neck with thin iron wire. The glass tube ought to have the same diameter as that of the brass hose socket, and, like that, should also be corrugated. The glass tube is next connected with a cyanogen gas yielding apparatus, best constructed for this purpose of a piece of combustion-tube, connected with a contrivance for condensing the mercury, filled with cyanide of mercury, and placed in a combustion furnace. By gradually lowering the empty flask, which has been placed highest, the other flask, which contains mercury, becomes gradually filled with cyanogen gas, the mercury running off. The first-mentioned condensation-tube apparatus is next placed in a freezing mixture, consisting of ice, common salt, and some chloride of calcium, yielding a temperature of -25°. The cyanogen-yielding apparatus having been first removed, the glass tube is connected with the brass hose socket of the condensation apparatus, kept in the freezing mixture, by elevating the litre-flask filled with cyanogen gas, and causing the mercury it at first contained, and which had run into the other empty litre-flask, to run into the flask containing the cyanogen gas; that gas is forced into the condensation apparatus, the stopcock of which is closed;

immediately after, the flask which contained the cyanogen gas is filled with mercury again. The condensation apparatus, having been disconnected from the flasks, is taken out of the freezing mixture, and will be found to contain about 5 c.c. of liquefied cyanogen, which keeps unaltered for weeks, and can be experimented with by means of the stopcock fitted to the apparatus.—*Berichte d. Deutsch. Chem. Gesell. zu Berlin.*

## PROCEEDINGS OF SOCIETIES.

### ROYAL INSTITUTION OF GREAT BRITAIN.

*Notes of a Course of Seven Lectures on Electrical Phenomena and Theories.* By Professor TYNDALL, LL.D., F.R.S.

(Continued from p. 106.)

#### *Magneto-Electricity: Induced Currents.*

274. In a conductor near to, but not in contact with, a voltaic circuit, a current is aroused when the circuit is established. When the circuit is interrupted, a current is also aroused in the conductor.

275. Thus, supposing the voltaic circuit to be bent into the shape of a ring; and that a second ring, not in the circuit, is placed near the first: at the completion, and at the interruption of the circuit, a current will run round the second ring.

276. The two currents in the second ring are called *secondary* currents. They are of momentary duration. They impart, in passing, a shock to a magnetic needle round which they are sent, and by the motion of which their existence is demonstrated. But they vanish immediately, being quenched by the resistance of the ring and converted into heat.

277. These two momentary currents flow in opposite directions through the ring. The secondary current, excited on making the circuit, is opposed in direction to the primary exciting current; that started on interrupting the circuit flows in the same direction as the primary.

278. These secondary currents are called *induced currents*. They were discovered by Faraday in 1830, and described by him in his Philosophical Papers for 1831.

279. If, instead of employing a single ring, we make use of an electro-magnetic helix, every coil of the helix will furnish its quota of current, and the sum total of effect is much greater than when only a single ring or coil is employed.

For the following experiments, two flat spirals, each formed of covered copper wire, are used.

280. One of the spirals is laid flat upon a table, its two ends being connected with a galvanometer; the other spiral is connected with a voltaic battery, with which the connection can be established or broken at pleasure. Let us call this the *inducing* or *primary* spiral, and that connected with the galvanometer the *secondary* or *induced* spiral.

281. Laying one spiral upon the other, on sending a current through the primary, the needle of the galvanometer is suddenly driven aside by the current induced in the secondary; but the force which acts upon the needle passes away in an instant, the needle returning to its first position.

282. On interrupting the current the needle also receives a shock, being deflected in the opposite direction. It thus declares the existence of a second temporary current in the secondary spiral. The directions of these two currents, with reference to that of the primary, have been already indicated (Note 277).

283. Holding the secondary spiral at a distance from the primary with the current flowing through the latter; on causing the secondary spiral to *approach* the primary, a current is aroused; this current ceases the moment the motion towards the primary ceases.



284. On *withdrawing* the secondary spiral from the primary, a current is also aroused; this current also ceases the moment the motion of withdrawal ends.

285. The current excited by approach is opposed in direction to the primary; the current excited with withdrawal is in the same direction as the primary.

286. Two electric currents flowing in the same direction attract each other; if they flow in opposite directions they repel each other.

287. Hence, to make the secondary spiral approach its primary, we have to overcome a *repulsion*; while to withdraw the secondary from the primary we have to overcome an *attraction*. Thus, in order to produce these induced currents, *we must expend mechanical force*.

288. The force thus expended appears as heat in the secondary wire after the cessation of the induced current. It is the mechanical equivalent of that heat.

289. The approach of a magnetic pole to the secondary spiral and the withdrawal of the pole from the same spiral also arouse induced currents. But, as before, it is only during the periods of approach and withdrawal that the current appears.

290. Thus by the mere motion of a magnet, and without any battery or machine, electric currents may be produced.

291. Every change of the magnetic condition of the space near a secondary coil or within it produces an induced current in the coil. If the change be an augmentation of magnetism, the current is in one direction; if it be a diminution of magnetism, the current is in the opposite direction.

292. When a long secondary coil surrounds a primary coil with a core of iron, by breaking and making the circuit of the primary in rapid succession, a series of powerful discharges may be obtained. An automatic apparatus is usually employed to make and break the circuit.

293. Such induction coils have been constructed with great skill by Ruhmkorff, and are, therefore, sometimes called Ruhmkorff's coils. Mr. Apps has recently produced induction coils of astonishing power.

294. The power of a coil depends mainly on the perfection of the insulation of its coils. The induced currents in a Ruhmkorff's coil may possess thousands of times the electro-motive force of the primary which excites them. They are able, for example, to overleap as sparks distances thousands of times greater than that possible to the primary,

#### *Relation of Induced Currents to the Lines of Magnetic Force.*

##### *Rotatory Magnetism.*

295. The foregoing phenomena and principles were all laid bare by Faraday. He also established most important relations between his induced currents and the lines of force surrounding a magnet. (See Note 25).

296. He proved that when a conductor moves *along* the lines of force no induced currents appear; but when it moves *across* the lines of force such currents are generated.

297. He proved, for example, that when a metal disk is caused to rotate so as to be tangent to the lines of force, no current appears; while when the disk, in its rotation, *cuts* the lines of force, currents flow along the disk, from the centre to the circumference and from the circumference to the centre. Closed circuits are thus established in the disk.

298. This, in fact, is the "Magnetism of Rotation," discovered by Arago in 1820, which received complete explanation at the hands of Faraday.

299. Faraday showed that the lines of force of terrestrial magnetism suffice to produce induced currents when they are intersected by the rotating disc. In fact, all the effects of magneto-electric induction may be obtained from the magnetism of the earth.

300. When a conductor rotates round an axis which is parallel to the lines of force, it experiences simply the resistance due to the friction of the air; but if the axis of

rotation be transverse to the lines of force, the rotation is retarded by the interaction of the magnet and the induced currents.

301. This retardation may become so powerful as instantly to arrest the rotation. If, for example, a cube or sphere of copper suspended from a twisted string be caused to spin, by untwisting, between the poles of an unexcited electro-magnet, it experiences the retardation due to air friction only; but, on the supervention of the magnetic force, the rotation is suddenly arrested. Faraday also showed that in passing a plate of copper rapidly to and fro between the magnetic poles you seem to be cutting cheese, though nothing is visible. It is as if pure space were a kind of solid.

302. If by mechanical means the conductor be compelled to rotate or to move to and fro between the excited poles, it will be heated. Joule first demonstrated this; but a very striking demonstration of it was given by Foucault, who heated his celebrated gyroscope in this way. The heat is readily rendered sufficiently intense to melt fusible metal. Between the unexcited poles no effect of this kind is produced.

303. The repulsion set up by induced currents between the helices and the moving masses of iron in an electro-magnetic engine, would of itself limit the practical application of electricity as a motive power. Nevertheless, though such engines speedily reach the limit of their action, the conversion of molecular force into mechanical effect may be rendered far more perfect than in the case of the steam-engine.

#### *The Extra Current.*

304. If the secondary coil of a Ruhmkorff's machine have its ends united, the secondary circuit being then complete, the spark obtained in breaking the primary is small. On separating the two ends of the secondary the primary spark is instantly augmented.

305. The diminution of the spark is due to the reaction of the completed secondary circuit upon the primary. When the secondary circuit is interrupted, this reaction ceases.

306. The primary circuit in its turn can, when complete, react upon the secondary. It is complete whenever contact is *made* by the automatic contact-breaker. A great enfeeblement of the secondary current is the consequence. When the primary circuit is interrupted, the reaction does not exist; there is no enfeeblement, the full power of the secondary being developed. It is on this account that in Ruhmkorff's coil we obtain discharges *in a single direction* only, instead of discharges alternating in direction.

307. The reaction here referred to connects itself with what is called the *extra-current*.

308. When a current is sent through a single primary coil, the primary current excites in the wire which carries it, a secondary current opposed in direction to the primary. The primary arouses an antagonist in its own path, which, however, immediately disappears.

309. When the primary circuit is broken, a secondary current of momentary duration and having the same direction as the vanishing primary, is evoked in the coil.

310. Each of the two currents evoked *in the primary circuit itself*, at the commencement and at the cessation of the primary current, has been called by Faraday an *extra-current*.

311. The spark obtained on breaking the primary circuit is augmented in brilliancy and power by the extra-current.

312. If a second circuit be associated with the primary; if, for example, two covered wires are wound round the same reel; on making one of them a primary circuit, we have the brilliant spark due to the extra-current, *as long as the ends of the second coil remain unconnected*.

313. But the moment they are connected the extra-current in the primary circuit disappears; there is an instant reduction in the brilliancy of the spark.

314. This is an example of the reaction referred to in



Note 304. By the closing of the secondary circuit the extra-current is formed *in it* instead of in the primary one. Here, in fact, the extra-current becomes an ordinary induced current; it is only so long as it remains in the primary circuit that its distinctive name is applied to it.

(To be continued.)

## NOTICES OF BOOKS.

*Saggio di un Corso di Fisica Elementare, Proposto alle Scuole Italiane.* Da GIOVANNI LUVINI, Professore di Fisica Nella R. Militare Accademia di Torino. Quarta Edizione. Torino: 1868.

WHILE two of the most scientific nations of the world are engaged in a murderous strife, at which humanity shudders and the best intellects recoil, it is pleasant to hear the voice of Science from a land to which Science already owes much, and may look forward to peaceful conquests to which she will owe more. If war develops the manhood and the intellect of a country, it cannot be said to be an unmitigated evil, and there is much to encourage the hope, that Italy, made free and united by means of war, has awakened from the long torpor which lay upon her while she was divided and enslaved. There is hope for a nation when her schools are active, and a treatise on Physics of 750 pages has already reached a fourth edition and is used as a text-book by young Italy.

A few years ago we noticed in these pages the address of the President at the opening of the second session of the College of Chemistry at Naples,\* in which the backward condition of Italy, consequent on years of political misrule, was feelingly adverted to, while science was in as deplorable a condition as political liberty. In another critical notice we gave a specimen, on the authority of Melloni, of the kind of scientific teaching permitted under Austrian and Bourbon rule.† Certainly, if the work before us may be taken as an exponent of Italy's progress during the last three years, she has indeed made rapid advances in scientific culture, for this Treatise on Elementary Physics would do honour to any country however advanced.

It must not, however, be forgotten that a nation that lives on the recollection of her former freedom and greatness, and never willingly consents to servitude and oppression, has a wonderful elasticity in recovering her rectitude when the weight of tyranny has once been shaken off. Such is Italy, and now that she is happily free and united, she not only looks back to her former fame, but forward to support and maintain her old renown. Hence, in the treatise before us, the scientific glories of Galileo, Torricelli, Venturi, Volta, Melloni, Matteucci, and a host of others, not forgetting modern workers, are quoted on every opportunity with that honest pride which a man feels when he can say "I too am a countryman of Galileo!"

This frequent reference to Italian *savans* gives a peculiarly national tone to the work, and in many respects increases the interest we feel in it. It is too much to expect that the order of scientific freemasonry will ever be established in which all the labourers in the field of Nature shall regard each other as Brethren; the stronger claims of race will prevail, and the *savan* will always be ready to accept the formula, "My country first—even Science must yield to that." *Patriæ fumus igne alieno luculentior.*

We can best illustrate the national feeling to which we refer by quoting the following passage, in which it seems odd to miss the name of Francis Bacon.

After some remarks on the defects of the peripatetic philosophy, the author says:—"It required all the power of a Leonardo da Vinci, of a Benedetti, and, above all, of a Galileo, to recall the attention of the studios to the methods of observation, experiment, and calculation. From the moment when it came to be generally understood

that, in the physical sciences, Truth, rather than Authority, must be the guide, there arose a whole generation of explorers of Nature. A vast variety of new phenomena were discovered, which, by their reciprocal action, corrected, while enlarging, the sphere of observation, thus laying the foundation of productive theories, which, in their turn, being successively corrected and renewed, assisted in the discovery of new facts, having served, and still serving, to colligate things apparently unconnected, thereby facilitating the study, while improving the stature, of the body of science."—Page 82.

This pride in her scientific men (from which England is comparatively free) has many advantages. It is not only a stimulus to scientific workers, but it assists scientific work. When, instead of leaving the works of men of genius in dusty oblivion on the shelf, the scientific teacher shows himself to be well acquainted with the scientific literature, at least, of his own country, his class, unconsciously adopting the habits of thought of the teacher, begin to cherish the memory, and to peruse the works, of their countrymen who have enlarged the boundaries of knowledge. The aid thus given to the history of discovery is illustrated, in a remarkable manner, by an extract from Galileo, which we meet with in the work before us at page 285. We had never supposed there was any doubt as to the authorship of Chladni's sound figures, and yet we read that Galileo, while scraping a plate of brass, noticed that the dust on the plate arranged itself in equidistant parallel streaks, and, by varying the notes, the figures also varied. Among the notes produced were two, which, by comparison with a viol, were found to differ by a fifth. Measuring the spaces formed by the dust lines, in the two cases, he found 30 of the one equal to 45 of the other, "quale veramente è la forma che si attribuisce alla diapente."

The treatise before us, in addition to the usual subjects of Physics, contains an outline of the Mechanical Sciences, including Astronomy, of the Atomic Theory, and numerous details which we now include under Chemical Physics. The chapters on Cohesion and Adhesion are remarkably well done. The author is not afraid to question certain received doctrines, and to express his belief that the theory of capillary action, as propounded by Clairaut, La Place, and Poisson, represents some clever applications of the calculus rather than of Nature. His own demonstration of capillary action is neat and clear. He also gives some of the latest details respecting surface tension, and copies the figures of Plateau, Van der Mensbrugghe, and Tomlinson, and gives some new figures of his own.

Thus, while the book is essentially Italian, in consequence of its numerous references to Italian *savans*, past and present, the author, nevertheless, looks out of Italy, and does not forget that there are successful *savans* elsewhere.

But the work has yet other claims to respectful attention. The author does not fall under the reproach, implied in Davy's remark on Berzelius, "He is only a chemist!" Prof. Luvini occasionally indulges in metaphysical subtleties, which are, among other benefits, so far useful, in reminding us of the narrow limits of our powers, that when we seek for a definition of the *matter* on which we work, or of the *mind* by which we work, we are reduced to the humiliating conclusion, that "as matter is the mysterious something which excites the mind to feel, so mind is the mysterious something which feels and thinks."\* There is also an occasional touch of sarcasm in what may be called the bye-play of the lecturer, when, as if speaking to himself, or thinking aloud, he remarks—say, in reference to Dutrochet's mysterious epipolic force—"Fine times those, when the creation of a name was deemed equivalent to the exposition of a fact!"—Page 226.

We also especially admire the author's love of poetry,

\* CHEMICAL NEWS, vol. xv., p. 238.

† *Ibid.*, vol. xv., p. 185.

\* See Mill's "Logic," ch. iii., § 8.



which gives a charm to his style and a breadth to his teaching. Such teaching must have the best effect on the young men of his class who come to learn physics (and it must be their own fault if they fail to do so), and while acquiring this knowledge are reminded by various side touches that the literature, the art, and the science of a country are under mutual obligations to each other.

It is difficult to select a passage that will convey an idea of the work as a whole, or even of the author's style, unless it could be given in the beautiful language of the original, for our author, in common with the French *savans*, seems unconsciously to adopt the maxim that scientific teaching is improved by a clear and graceful style: we will, however, venture to translate a passage from the end of the chapter on Chemical Actions.

"We were formerly accustomed to say that the power of the chemist was limited to the artificial formation of inorganic bodies only." The progress of organic chemistry has already swept aside this limitation. But, in truth, all chemical products proceed from the hand of Nature; all that man does is to bring together the elements destined to mutual reaction. Whether we decompose water, oxidise zinc, crystallise sulphur, or fuse gold, we do nothing more than what Nature herself does in bringing about the same results. Is it not by realising the necessary conditions that the gardener produces the immense variety of plants and the grazier the best animals? or, as the poet well expresses it,—

'If in the maw of the serpent the juice is transformed into poison,  
Still it becomes sweetest honey when hid in the bag o' the bee.'

"The whole difficulty consists in knowing and being able to dispose of matter in such a manner as to bring about those reactions that lead to the changes we are in search of."—Page 262.

The scientific formulæ given in the work are of an elementary character, but sufficient to redeem it from being superficial, which some so-called popular treatises are. We may further remark that the author is himself an original worker, or he could not have produced so excellent a treatise. A translation of a paper by Professor Luvini on the viscosity of liquids will be found in the September number of the *Philosophical Magazine*.

C. T.

Highgate, N., August 25th, 1870.

*Heat a Mode of Motion.* By JOHN TYNDALL, LL.D., F.R.S., &c., Professor of Natural Philosophy in the Royal Institution of Great Britain. Fourth edition. London: Longmans, Green, and Co., 1870.

THE very fact of the fourth re-issue of this work is an undeniable proof of the excellence of its contents. The author has bestowed upon this edition additional care, and enriched it with some account of his recent researches on the chemical reactions of light, considered from a dynamical point of view. In the former editions the relations of gaseous matter to the longer waves of the spectrum were developed; in this one the relations of the same form of matter to the shorter waves are also submitted to experimental treatment, the two lines of inquiry being united by the conception of molecular motion, which is common to both. The bearing of some of the results on two of the great questions of meteorology—the Blue Colour of the Sky, and the Polarisation of its Light—is likewise explained and pointed out. The author has also added a hypothesis regarding the Constitution of Comets, and a few remarks on the Polarisation of Heat. This edition is greatly enlarged, its contents are rendered more interesting, and are made complete up to the present date. The eminent author deserves the sincere thanks of all who can appreciate, and we hope very many do, the insight he is gradually acquiring into this department of natural science. As is generally the case with books published by this firm, the work is highly commendable for its typographical execution and excellent engravings and woodcuts.

## CORRESPONDENCE.

### TEMPERATURE AND HEATING-POWERS OF FLAMES.

*To the Editor of the Chemical News.*

SIR,—In your last number Professor Wurtz replies to my criticism on the paper of Professors Wurtz and Silliman on the "Calorific Powers or Effects of Gases."

Professor Wurtz first of all charges me with inattention to his paper, and with confusion of ideas—in suggesting that by the term "heating effect of a gas," he really means the "flame-temperature"—and then, in the last paragraph, acknowledges that the numbers given in my note (which are calculated flame-temperatures), are precisely what he has designated as calorific powers or effects. The term "calorific power" is a term in common use, and to be carefully distinguished from "calorific intensity," which is synonymous with "flame-temperature." Professor Wurtz certainly uses the term "calorific effect" for the numbers calculated by Bunsen's formulæ, whereas "calorific power" has always been used to mean the quantity of heat produced by the combustion of a given weight of the substance. It is used in this sense by Percy in his "Metallurgy," and indeed is employed in that sense by Professor Wurtz himself in part of his paper.

But the real point at issue between us is not a question of terms at all, but of facts, and in order that this may be clearly understood, I must beg permission to quote from the original paper somewhat at length. Professors Silliman and Wurtz write:—

"The admirable researches of the great gas-chemist, Bunsen, of Heidelberg, placed in our possession, some years ago, the means of computing, at least with approximate accuracy, the heat of flames of gases of known compositions. Few, however, have properly and successfully applied Bunsen's method in practice. We consider it quite time that these methods should be introduced to the knowledge of gas-engineers, in forms available to them.

"Bunsen's formulæ for these computations are based upon the actual experimental determinations of the total amounts of heat developed by the combustion of different pure combustible gases with pure oxygen made by Favre and Silbermann, and upon Regnault's determinations of the specific heats of gaseous products of combustion.

"It is not to be maintained that Favre and Silbermann's numbers are strictly correct, but they are doubtless approximate, and at least proportionately correct among themselves; at any rate, they are the best data we have. Those employed here are included in the following table. They are usually given in the text-books for equal *weights* of the gases; but we have reduced them to the standard of equal *volumes* also, as more suitable to our present purpose. This reduction is made simply by multiplying the equivalents for weights by the densities as given in the third column.

TABLE I.

	Total caloric equivalents		Densities on scale of hydrogen = 1.
	Of equal weights.	Of equal volume.	
Carbonic oxide	34,462° C. . .	34,462° C. . .	1.0
Hydrogen . .	2,403° . .	33,642° . .	14.0
Marsh gas . .	13,063° . .	104,504° . .	8.0
Olefiant gas . .	11,858° . .	166,012° . .	14.0

"The meaning of this table is simply that equal weights of water would be heated by the several gases to temperatures proportional to the numbers in the first column when equal *weights* of the gases are burned, and propor-



tional to those in the second column when equal volumes are burned.

"A cursory glance at the figures in the second column of this table might seem to justify the notion hitherto entertained by many of the comparatively low calorific powers of hydrogen and carbonic oxide; and it was doubtless as a consequence of such a comparison as this that statements have been put forth and widely accepted among American gas-engineers to the effect that the weight of water heated from the freezing to the boiling-point by 1 cubic foot of the four main components of illuminating-gas, respectively, is as follows:—

Hydrogen .. ..	2.22 lbs. water
Carbonic oxide .. ..	2.16 "
Marsh gas .. ..	6.17 "
Olefiant gas .. ..	10.74 "

"The figures here being obviously about in the same ratio as those in the second column of Table I. Several most grave errors, however, are here involved. To get at the true relative calorific effects of the above gases, when burned in the open air, in heating water below its boiling-point, deductions must be made, not only for the *specific heats* of the products of combustion of the gas, but also (more important still) for the specific heat of the *nitrogen of the air* required to burn the gas. In fact, when we consider that, for each volume of oxygen required to burn a given volume of a gas, about *four volumes* of nitrogen must be heated up to the temperature of the flame, it becomes easy to conceive, what is actually the fact, that, within certain limits, the waste of heat due to this cause alone counterbalances altogether the advantage that would be supposed to result from the crowding of combustible matter into so condensed a form as in the illuminating hydrocarbons. An inevitable result of our investigations of this matter is that the heating powers of the flames of pure hydrogen and pure olefiant gas, even when used to the greatest advantage, to heat water below its boiling-point are almost or quite identical."

Now, I venture to assert that the numbers just quoted, in which, according to Professor Wurtz, "several most grave errors are involved," are substantially correct—that the specific heats of the products of combustion and of the nitrogen of the air required to burn a gas have nothing whatever to do with the maximum calorific effect of the gas, and that, instead of the powers of the flames of hydrogen and olefiant gas to heat water below its boiling point being identical, olefiant gas will be always nearly five times as effective as the same volume of hydrogen burnt under the same circumstances.

Professor Wurtz admits the justice of my objection to his statement that the heating effect of olefiant gas is ever lower than that of carbonic oxide, if the combustion take place in pure oxygen, but affirms that it has no force if the combustion take place in air.

I must plead guilty to want of precision in not clearly stating that I was speaking of combustion in air (my statement that the flame-temperature of carbonic oxide is higher than that of olefiant gas is not even true if the combustion take place in pure oxygen), and in not pointing out that the reason why the flame of olefiant gas in air is colder than that of carbonic oxide in air, although the quantity of heat produced by its combustion is so much greater, is not only the latent heat and the high specific heat of the steam produced in the former case, but also the larger quantity of nitrogen, which is one of the products of combustion. But, surely, whatever the products of combustion are, when they are made to give up their heat to water they must give out exactly the same quantity of heat which was required to raise them to the temperature which they possessed; and, thus, the effect of a gas in heating water will be the same, whether it be burnt in oxygen or in air, and will be correctly measured by the calorific equivalent (of equal volumes) given in the table quoted above. The number for olefiant gas being nearly five times that for hydrogen, my state-

ment is justified that the flame of olefiant gas is nearly four times as efficient in heating water below 100° as the flame of hydrogen. Professor Wurtz may object that this is true only if the products of combustion give up all their heat and escape themselves at a temperature of 0° C., which is, of course, impossible. The following results of calculation show that if the products of combustion escape at a temperature above 100° C., olefiant gas is even more than five times as efficient as the same volume of hydrogen.

The combustion in air of	Will raise from 0° to 100° C.	If the products of combustion escape at the temperature
1 lb. hydrogen ..	344.62 lbs. water	0° C.
14 lbs. olefiant gas..	1660.012 "	0° C.
1 lb. hydrogen ..	329.1 "	100° C.
14 lbs. olefiant gas..	1593.7 "	100° C.
1 lb. hydrogen ..	184.17 "	1000° C.
14 lbs. olefiant gas..	984.16 "	1000° C.

—I am, &c.,

W. MARSHALL WATTS.

Manchester Grammar School,  
Aug. 29th, 1870.

## MISCELLANEOUS.

**Recent Chemical Appointments.**—Mr. T. E. Thorpe, Ph.D., of Manchester, has been elected Professor of Scientific Chemistry at Anderson's University in the room of the late Professor Penny. Dr. Thorpe has for some time held the post of Junior Assistant in the Chemical Laboratory at Owen's College, where his talents and zeal have been fully appreciated. Dr. Debus, F.R.S., has been appointed to succeed Dr. Alfred Swaine Taylor, F.R.S., as Professor of Chemistry at Guy's Hospital Medical School. Dr. Debus is succeeded, as Lecturer on Natural Science at Clifton College, by Mr. G. Farrer Rodwell, F.C.S., whose originality of thought and powers of description, combined with his high scientific attainments, well qualify him for the appointment.

**University of London.**—The following are lists of the candidates who have passed the recent M.B. and B.Sc. examinations:—*First M.B. Examination (Examination for Honours).*—Organic Chemistry, and Materia Medica and Pharmaceutical Chemistry: First Class. Chas. Atkinson Nankivell, Exhibition and Gold Medal, University College; William Smith Greenfield, University College, and Ebenezer Geer Russell, Guy's Hospital (equal); George Birt, Sydenham College, Birmingham. Second Class. Sidney Coupland, University College; Henry James Benham, University College. *First B.Sc. and Preliminary M.B. conjointly.*—Chemistry: Second Class. Henry Hetley, Prel. Sci., Guy's Hospital; P. Herbert Carpenter, First B.Sc. and Prel. Sci., University College and Royal School of Mines. Third Class. F. John Morton Palmer, Prel. Sci., Guy's Hospital, and Ernest William White, Prel. Sci., King's College (equal); Eugène Crétin, Prel. Sci., St. Bartholomew's Hospital, and Thomas King Rogers, Prel. Sci., University College (equal); H. Joseph Firth Groves, Prel. Sci., Guy's Hospital. Experimental Physics: Second class. John Landor Lowe, First B.Sc., King's College.

**British Association for the Advancement of Science.**—The following is the programme of the arrangements for the fortieth annual meeting of the British Association for the Advancement of Science, to be held in Liverpool, commencing on Wednesday, the 14th inst. President-elect—Professor Huxley, LL.D., F.R.S. Vice-Presidents-elect—The Right. Hon. the Earl of Derby; Right. Hon. W. E. Gladstone, M.P., D.C.L. Sir Philip G. Egerton, Bart., M.P., F.R.S.; Sir Joseph Whitworth, Bart., LL.D., F.R.S.; S. R. Graves, Esq., M.P.; J. P. Joule, Esq., LL.D., F.R.S.; Joseph Mayer, Esq.,



F.S.A. Chairman of Local Executive Committee—The Mayor of Liverpool (Joseph Hubback, Esq.) Local Treasurer—Henry Duckworth, Esq., F.G.S. The sections are:—A—*Mathematical and Physical Science* (in the Crown Court, St. George's Hall): President—J. Clerk Maxwell, F.R.S.L. and E.; Secretaries—Prof. W. G. Adams; W. K. Clifford; Prof. G. C. Foster, F.R.S.; Rev. W. Allen Whitworth. B—*Chemical Science* (in the Royal Institution, Moore Street): President: Prof. Henry E. Roscoe, PhD., F.R.S., F.C.S.; Secretaries—Prof. A. Crum Brown, F.R.S.E., F.C.S.; A. E. Fletcher, F.C.S.; Dr. W. J. Russell, F.C.S. C—*Geology* (in the Concert Hall, Lord Nelson Street): President—Sir Philip de Malpas Grey Egerton, Bart., M.P., F.R.S., F.G.S.; Secretaries—W. Pengelly, F.R.S., F.G.S.; Rev. H. H. Winwood, F.G.S.; W. Boyd Dawkins, F.R.S., F.G.S.; G. H. Morton, F.G.S. D—*Biology* (in the Reading Room and Lecture Room of the Free Public Library): President—Prof. G. Rolleston, M.D., F.R.S., F.L.S.; Vice-Presidents—John Evans, F.R.S., F.G.S., F.S.A.; Prof. Michael Foster, M.D., F.L.S.; Secretaries—Dr. T. S. Cobbold, F.R.S., F.L.S.; Thos. J. Moore; H. T. Stainton, F.R.S., F.L.S., F.G.S.; Rev. H. B. Tristram, LL.D., F.R.S. E—*Geography* (in the Small Concert Room, St. George's Hall): President—Sir Roderick I. Murchison, Bart., K.C.B., D.C.L., LL.D., F.R.S., F.G.S.; Secretaries—H. W. Bates, Assist. Sec. R.G.S.; Clements R. Markham, F.R.G.S.; Albert J. Mott; J. H. Thomas, F.R.G.S. F—*Economic Science and Statistics* (in the Council Chamber, Town Hall): President—Prof. Jevons; Secretaries—E. Macrory; J. Miles Moss. G—*Mechanical Science* (in the Civil Court, St. George's Hall): President—Charles Vignoles, C.E., F.R.S., M.R.I.A., F.R.A.S.; Secretaries—P. Le Neve Foster; J. T. King. General and Evening Meetings—Wednesday, Sept. 14: The first general meeting will be held in the Philharmonic Hall, at 8 p.m., when Professor Stokes, M.A., D.C.L., will resign the chair, and Professor Huxley, LL.D., F.R.S., will assume the Presidency and deliver an address. Thursday, Sept. 15: The Mayor's First Reception at the Town Hall. Friday, Sept. 16: Lecture in Philharmonic Hall, at 8.30 p.m., by Professor Tyndall, LL.D.; the Mayor's Second Reception at the Town Hall. Saturday, Sept. 17: Address to Working Men, in Concert Hall, Lord Nelson Street, at 8 p.m., by Sir John Lubbock, Bart., M.P., F.R.S. Monday, Sept. 19: Lecture in Philharmonic Hall, at 8.30 p.m., by Professor Rankine, LL.D., F.R.S. Tuesday, Sept. 20: Soirée in St. George's Hall, at 8 p.m. Wednesday, Sept. 21: Concert in St. George's Hall, at 8 p.m. Thursday, Sept. 22: Excursions to several places. Members requiring Railway Pass Tickets and further information should apply to any of the following Hon. Local Secretaries—Wm. Banister, B.A.; Reg. Harrison, F.R.C.S.; H. H. Higgins, M.A.; A. Hume, D.C.L., LL.D., Municipal Buildings, Dale Street, Liverpool.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus des Séances de l'Académie des Sciences, August 22, 1870.

This number does not contain any papers or memoirs relating to chemistry, but, among the few published relating to physical sciences, we notice—

Note on the First Session of the International Committee of the Metrical System, which met at Paris from the 8th to the 13th of August last.—General Morin.—We learn from this paper that twenty out of the twenty-five States which accepted the invitation were represented at this meeting; these States are—The Austro-Hungarian Empire, Chili, Columbia, Spain, Papal States, United States of America, Republic of Ecuador, United Kingdom of Great Britain and Ireland, Greece, Italy, Nicaragua, Peru, Portugal, Russia, San Salvador, Sweden and Norway, Switzerland, and Turkey. The meeting has appointed—President, M. Matthieu. Vice Presidents—M. Struve, of St. Petersburg; Dr. W. A. Miller, London; M. Henry, Secretary of the Smithsonian Institution, Washington, U.S.; M. Herr, Vienna; General Morin. Secretaries—M. Tresca, Paris, and M. Hirsch, Neuchâtel, Switzerland. The Committee, having fixed upon the programme of their labours, and having appointed sub-committees, has adjourned its meetings *sine die*.

Phenomenon of Choc en Retour observed at Porto-Alegre (Brazil).—M. Laranja Oliveira.—The author writes—One of my servants had to walk home, in the early part of last June, during a violent thunderstorm. When at about 100 metres' from my residence, in the outskirts of this town, and just when a violent flash of lightning appeared, he felt suddenly as if his body was everywhere pricked with needles, his feet were temporarily lamed, and the hair of his head raised upright to such an extent as to oblige him to hold his hat with his hands to prevent it from falling off; close to him (at about 2 metres' distance) he saw, near to the ground, a whitish smoke, which emitted flashes of vivid lightning, it being about midnight. After having recovered, and arrived home, he discovered that a key he happened to have had in his pocket had become strongly magnetic.

August Meteorites of this Year.—M. Chapelas-Coulvier-Gravier.—The author states that this year is exceptional, as regards the scarcity of meteorites seen generally; he next enumerates some of the causes which co-operate to render the observation of the meteorites more difficult, as there are, for instance, cloudy sky and strong moonlight; lastly, the author gives the names of the constellations wherein most of these luminous meteors have been seen during the month above named.

Moniteur Scientifique, No. 328, August 15, 1870.

This number does not contain any original memoirs or papers, but we quote the following from the *brevets d'invention*:—

Improvements in the Manufacture of Animal Charcoal.—MM. Pilon and Co., Paris.—This improvement simply consists in the granulating of the bones previous to their calcination, the result being that the quantity of dust and small (useless for the purposes of the sugar refiner, and of inferior value for agricultural purposes) is very considerably lessened. The bones, of course, have been first boiled, and the fat extracted by proper means.

Manufacture of Sal-Ammoniac Combined with the Production of Peroxide of Manganese.—L. J. Martin.—Of the residues of the manufacture of chlorine, 600 kilos. are mixed with 100 kilos. of ammonia (sp. gr., 0.924). This magma is first somewhat evaporated; and, after the clear liquid has been decanted, it is evaporated to dryness, and then sublimed, while the manganese is slowly peroxidised. The editor of the above-named periodical very properly observes that, although, in theory, such a process might answer, it is, even with small quantities, not of any practical utility.

Girondin Disinfectant.—G. Vigué.—The author mixes, but does not say in what quantities, sulphate of zinc, acetate of copper, carbolic acid, and crystals and essence (*sic*) of baryta, to be together dissolved in water. No explanation is given as to what essence of baryta means.

Manufacture of Steel Types for Typographical Use.—G. Bauer.—By an ingenious mechanical contrivance, not unlike that in use for making nails, the author converts previously-softened steel wire into types which are afterwards hardened. With a single machine, and a 1-H.P. steam-engine, 35,000 types can be made in twelve hours, while the types thus made are of a superior finish, and cheaper also, on account of the less expense of the steel as compared with the ordinary type metal (usually an alloy of antimony and lead, in the proportion of 1 part of antimony to 4 of lead, with a very small quantity of copper, the latter being usually present in sufficient quantity in what is termed hard lead).

As a curiosity, we mention the following:—

Pomatum for Softening and Whitening the Skin.—H. Freymond.—The author has taken a *brevet d'invention* for a mixture of olive oil, lavender essence, white wax, oil of turpentine, mutton suet, and common carmine. This would, no doubt, do very well for French polish, but the oil of turpentine would render it highly unpleasant, to say the least of it, to those who should apply it to their skin, and especially lips.

Les Mondes, August 18, 1870.

Soluble Vegetable Tar (Sacharolé de Goudron).—A. Roussin.—The author states that he has succeeded in obtaining, by the use of pure sugar, a very useful pharmaceutical preparation to supersede the use of tar-water as made and applied from what is termed in this country Stockholm tar. The preparation is a powder of constant composition, and containing 4 per cent of the real active principles of the tar-water of the Pharmacopœia; it is highly spoken of by M. Gay, a very well known pharmacist, and Director of the pharmaceutical school at Montpellier.



**Toselli's Dynamical Refrigerator.**—The author describes, and illustrates with woodcuts, a contrivance consisting mainly of a tube wound round a central axis, and movable in a trough partly filled with water, and not unlike the trough in use for grindstones. By the rapid motion of the tube through the water, that fluid enters the tube; while the water which is outside of it evaporates rapidly, and, by that evaporation, causes the cooling of the water inside, which, by the developed centrifugal force, is carried through the windings of the tube, and thus affords means for obtaining a supply of comparatively cold water. The author has found, by experiment, that, even when the initial temperature of the water is  $36^{\circ}$ , it may be cooled down to  $18.5^{\circ}$ ; and when a ventilator is simultaneously used, so as to produce a strong current of air upon the convolutions of the tube, and thus accelerate the evaporation, the cooling effect is greatly increased. The speed to be given to the metallic tube is very moderate.

August 25, 1870.

**Useful Applications of the Electric Light.**—F. E. Pâris.—This lengthy paper chiefly treats of the application of the electric light to lighthouses, as signal-lamps on board ships, and also for affording light to narrow channels near the mouth of rivers, and for rendering approach to harbours possible during the night time. The author has experimented with various magneto-electric machines, and gives, in detail, the requisite instructions for the management of electric lights for the purposes above alluded to.

**Silver Mine of Potosi.**—This mine, situated in the Andes of Peru, is considered the highest mine wrought in the world, as regards its elevation above sea level, which is 3465 metres; while the deepest mine under the sea level is the salt mine of Neusalzwerk (Westphalia), which is 625 metres below the sea.

**Composition of Chinese Lacquer-Work.**—Dr. Wiederhold.—According to the author, genuine Chinese lacquer-work is done over tin-foil, and consists of a mixture of 2 parts of copal and 1 of shellac, molten together. When fluid, there are added 2 parts of boiled linseed oil; and, after the vessel containing this mixture has been taken from the fire, there are gradually added 10 parts of oil of turpentine. If colour is required, gummi-gutta, dissolved in oil of turpentine, yields yellow, and dragon's blood, dissolved in the same liquid, yields red.

**Artificial Ice.**—M. Toselli.—The author, writing to the editor of the above-named periodical, states that actual experience has proved that the ice made by the process invented by him withstands the influence of a temperature far above the freezing-point of water better than natural ice, or than any other ice obtained by artificial means; and to illustrate this fact, the instance, properly proved, is brought forward, that a block of ice weighing 20 kilos., made by the author's process in eighteen minutes, and sent off from Paris to Algiers on the 30th of June last, arrived, properly packed, at its destination late in the afternoon of the 5th of July, and the block of ice then remaining still weighed 10 kilos. The loss, by fusion, on a journey through a warm climate in the middle of summer was, therefore, only 84 grms. per hour. 100 kilos. of ice made by the author's process would require, under the same conditions of temperature,  $49\frac{1}{2}$  days to liquefy it; whereas 100 kilos. of the ice artificially made by the process of M. Tellier, has been found to melt in six days under the same conditions. It appears that M. Toselli's apparatus renders ice very compact.

*Journal de Pharmacie et de Chimie*, August, 1870.

This number contains the following original papers and essays:—

**New Process for the Quantitative Estimation of the Alkaloids of the Cinchona and Calisaya Barks.**—P. Carles.—The author begins with giving a review of the different methods hitherto in use for the quantitative estimation of the alkaloids alluded to, which methods may be divided into two main classes—viz., those by which the whole of the alkaloids are estimated together, and those by which only the quinine is estimated. The author's new method is the following:—A fair average sample of the bark to be tested is ground up to a fine powder, and sifted, but any residue left on the sieve is to be pulverised again. 20 grms. of this powder are taken and intimately mixed, in a mortar, with 8 grms. of quick-lime, slaked, just previous to use, with 35 grms. of water. The pasty mass thus obtained is dried on a water-bath. As soon as the mixture has become dry enough to be broken up into small lumps, this is done, and the lumps placed in a funnel-shaped tube, the lower and narrower opening of which is closed by a plug of cotton wool. Chloroform is poured over the mass, a quantity of 150 grms. being sufficient, and the last traces of that fluid are washed off with some distilled water; the larger portion of the chloroform is either evaporated or (as may suit the operator) distilled off on a water-bath, and the residue taken up with from 10 to 12 c.c. of dilute sulphuric acid (1 of acid to 10 of water). This solution is poured on to a previously well-moistened filter, which retains the resinous matters, while a clear liquid runs off. The filtrate is boiled, and, when in full ebullition, ammonia is added to it, so as to leave only a slightly acid reaction; all the sulphate of quinine crystallises out, while the mother-liquor retains the rest of the alkaloids, which may be separated by precipitation and further tested. The author has added to his paper some tabulated results of experiments made by him with the same quantity of bark, and operating with various methods executed carefully, as described by the original authors and suggestors of these methods, in order thus to prove the superiority of his method.

**Soluble Iodide of Starch, and its Decolouration by Heat.**—A. Petit.—This paper treats on the proper method of preparing a pharmaceutical compound and a syrup of iodide of starch, and on the changes these mixtures undergo by the action of heat. It appears

that the cause of the well-known decolouration of iodide of starch by the application of heat is due to the complete solubility of that compound at a high temperature, and the temporary destruction of the combination existing at a lower temperature between starch and iodine.

**Heat Set Free by the Mixing of Two Liquids.**—M. Berthelot.—A letter to M. Bussy, only containing a series of algebraic formulæ.

**Basic and Neutral Bromhydrates of Quinine and Cinchonine.**—M. Latour.—The author describes the preparation, for pharmaceutical purposes, of compounds made up of bromide of potassium and sulphate of quinine. Some of these salts so obtained are really chemical combinations which, in their general characters, do not differ from chlorhydrates of quinine.

**Experimental Researches on Gold and its Compounds.**—J. P. Prat.—The main results of the author's experiments are—That nitro-muriatic acid chlorurises gold in various degrees, and that this depends upon the composition of the acid, the quantity which is applied in reference to the gold, and the degree of heat; that pure gold can be readily and rapidly prepared and obtained in spongy state; that gold can be directly oxidised and salified by oxacids; that there exists a liquid and volatile chloride of gold containing more chlorine than the sesquichloride; that there exists, likewise, a sesquiodide and a carbonate of gold; that there exist two oxides of gold capable of giving a new series of salts; and, lastly, that gold behaves in many instances like some of the other metals.

*Bulletin de l'Académie Royale des Sciences, des Lettres et des Beaux Arts de Belgique*, No. 5, 1870.

This number contains the following papers and memoirs relating to physico-chemical and collateral sciences:—

**On the Landen Sandstone.**—J. Moreau.

**Determination of the Declination and Inclination of the Magnetic Needle at Brussels in 1870.**—A. Quetelet.—A series of tabulated results.

**Note on the so-called Natural Pits (Puits Naturels) of the Coal Measures.**—MM. Cornet and Briart.—The description of certain hollow and deep faults also met with in some of the cretaceous formations, especially the *Maestricht tufa*, and known locally as geological organs.

**Determination of the Exact Latitude of the Tower of the Antwerp Church of Nôtre-Dame.**—A. Boë.—The author has determined this latitude by astronomical observations, and the result arrived at is, that the north latitude of the building alluded to is  $51^{\circ} 13' 14'' 98$ , a figure only differing by 2-100ths from that obtained nearly sixty years ago, by M. Krayenhoff, by geodesical measurement.

*Revue Universelle des Mines, de la Métallurgie, et des Travaux Publics de Belgique*, No. 3, 1870.

This number contains only the following original papers relating to physico-chemical and collateral sciences:—

**Motion of Permanent Gases through Pipes and Tubes.**—Dr. Grashof. And—

**Agglomeration of Fuel.**—A. Habets.—Both papers being continuations of the portions published in previous numbers of this periodical.

*Cosmos*, August 20, 1870.

**Lavoisier Medal.**—Upon the report and proposition of M. A. Payen, this medal has this year been granted to M. H. Sainte-Claire Deville, in consequence of the great number of useful researches made by that *savant* in chemistry, and the application these researches have received in practice. Among the subjects enumerated are—Researches on platinum; the industrial manufacture of sodium; the discovery of the hydraulicity of magnesia; the researches on the application of dead and other heavy hydrocarbon oils as fuel for steam-boilers; the dissociation of bodies by heat.

**Cause of the Fires of Pine Forests.**—F. Schrader.—The author very ingeniously observes that the cause of the very frequent fires of pine forests, in summer time only (large tracts of country in the Départements des Landes and de la Gironde are covered for miles and miles' distance with such forest, and remote from any habitations), is not due, as has been often surmised, to wilful arson or accidental imprudence, but is produced by the action of the concentration of the sun's rays upon the hollow globules of resin which exude from the trees, acting as burning lenses, and becoming inflamed; thus causing the combustion to begin, and, once begun, to spread rapidly, in consequence of the highly inflammable nature of the resinous and turpentine-containing wood.

**The Part Gaseous Substances Play in Volcanic Eruptions.**—J. Delanoue.—The main point of interest contained in this lengthy paper is, that hydrogen gas plays the chief part in the volcanic eruptive phenomena.

**Man of the Tertiary Period.**—M. Raulin.—The author states that, until the contrary be proved, he thinks that, just as there have been in the five successive faunas, five distinct species of rhinoceros, so the genus *Homo* may have been represented in each succeeding



fauna by species which become gradually more intelligent than their predecessors had been.

**Draining of the Dombes, and their Conversion into Fertile Fields.**—M. Givord.—By Dombes is understood a portion of the Département de l'Ain, comprising a surface of 90,000 hectares, situated between the rivers Rhone and Saone. In the 13th century this country was a most fertile plain, but about that time the inhabitants, for some reason or other, not specified, commenced making pools of water, now covering 14,000 hectares (the likelihood is that, as is the case in some parts of Holland, peat has been dug, and, by this process, shallow lakes of great surface have been formed); and, as a consequence, malaria spread among the inhabitants, causing, according to the author, such ravages as to sweep away even towns which once had 4000 inhabitants, to reduce the average duration of human life to twenty-one years (only half that of the rest of France), and to impoverish the scanty population. The author enters into details as to the draining of the pools alluded to, but his chief aim is to prove how the work of man may influence his own physical, as well as mental, well-being, and how necessary it is to carry out the drainage of this region.

**International Conference on the Prototype Metre.**—Dr. O. Struve, Director of the Observatory of the Pulkowa; M. Wilde, Director of the Physical Observatory and Museum at St. Petersburg; and M. Mohr, the Director of the Meteorological Institute of Christiania, have arrived in Paris, for the purpose of taking part in the international conference on the metre and the metrical system generally.

August 27, 1870.

**Luminous Phenomenon.**—Dr. Roussille.—The author states that, while making a geologico-botanical excursion on the Mount Pilat (Cévennes, France), on the 19th of July last, at sunrise (the temperature being 10.5°, the height above sea level 1288 metres, sky cloudy, and haziness prevailing, with a westerly wind), he suddenly saw the whole sky, as it were, in a fiery glow, the sun orange-coloured, and, looking to the westward, he saw the image of the mountain he was ascending crowned with two rainbows, placed one above the other, and separated from each other by a greyish band, while the rainbows, instead of the seven, only exhibited two colours. The clouds, continuing to move, soon came near to the author, who then distinctly observed his own image. In fact, what he observed and describes is very akin to the well-known Brocken spectrum of the Hartz Mountains, but with this distinction—that the phenomenon seen by the author of this brief notice has never been before noticed in the Cévennes.

**Reagent for Detecting Ammonia in Lighting Gas.**—V. Meunier.—The author prepares a sulphurico-alcoholic tincture of the fresh leaves of the *Coleus Verschaftelti*, by infusing these leaves with absolute alcohol, to which a few drops of sulphuric acid are added. Strips of Swedish filtering-paper are dyed with this tincture, and, after having been dried in open air, are kept in well-stoppered bottles. When required for use, this paper is slightly moistened, and, being tinged green by alkalies, even if only mere traces thereof are present, is a valuable test for ascertaining, according to the author's experience, the presence of ammonia in gas, by only holding a strip of this paper for a moment in a current of illuminating gas.

**Fertility of the Soil of Corsica.**—J. Casanova.—The author states that, notwithstanding the long-continued and exceptionally-severe drought, and without having applied to his fields any other than a light dressing of stable manure, he has reaped 416 decalitres of wheat per hectare, the straw being, moreover, of exceedingly good quality, and exceeding 1.6 metres in height. This amounts to about 114.4 bushels (English measure) to rather more than 2 acres' surface. It should be observed that the Island of Corsica, as well as the adjacent Island of Sardinia (Italian territory), are both in a highly backward state as regards agriculture, and, moreover, only a very small area of these countries is under tillage.

*Revue Hebdomadaire de Chimie*, July 28, 1870.

**Estimation of Glucose in Commercial Sugars.**—J. Midy.—The author prepares a Fehling test-liquor of such a strength that 100 c.c. thereof are completely decomposed by 1.05 grms. of uncrystallisable sugar (1 c.c. of the liquor agrees, therefore, with 0.0105 of glucose); a solution is also made of 20 grms. of the sugar to be tested in 150 c.c. of distilled water. To this solution, previously heated till near its boiling-point, is added, by means of a Mohr's burette (divided into 1-10th c.c.),  $\frac{1}{2}$  c.c. of the Fehling cupreous liquor; the sugar solution is withdrawn from the source of heat, and, after having been stirred up, the suboxide of copper, if any has been formed, is allowed to settle. When this has taken place, a very small portion of the liquid is filtered through Swedish filtering paper, and to the filtrate is added a drop of a concentrated solution of ferrocyanide of potassium and acetic acid. If too much of the cupreous test-liquor has been added, the addition of the reagents alluded to will have the effect of causing the formation of the well-known precipitate of ferrocyanide of copper; and, in that case, a fresh sugar solution has to be made, and only  $\frac{1}{4}$  c.c. of the cupreous test-liquor has to be added; and the ferrocyanide should not give indications of excess of copper in the filtered liquid as above alluded to. Such being the case, the operator knows that 20 grms. of sugar contain less than 0.0052, and more than 0.0026, of glucose; taking the average of these figures, which is 0.0039, and multiplying by 5, we learn that the sample of sugar tested contains about 0.0195 per cent of glucose.

**Plastic Material of Great Resistance Suitable for a Variety of Uses.**—M. Rost.—The author mixes litharge and glycerine, in such proportions as may suit the purpose, so that it may form a creamy

liquid or a pasty mass. The mixture becomes, in a short time, a hard, homogeneous mass, which readily adheres to metals, resists the action of water and steam, and a temperature of 275°. In many instances, this paste is preferable and very superior to red-lead cement (linseed oil and red-lead); and this glycerine-litharge paste may be even used, when in very fluid state, for galvanoplastic copying, since the material preserves even fine engraved lines.

August 4th, 1870.

**Naphthylamine Violet.**—M. Scheurer.—This preparation, consisting of chlorhydrate of naphthylamine and chloride of copper, properly thickened, yields, at the ordinary temperature of the air, and after a few days of ageing, a dull, but pure violet; but, if the temperature of the ageing-room be about 30°, and much moisture present, the operation is finished within thirty-six hours, but the colour is bad and requires a clearing. The author, while experimenting found that, in order to obtain a good violet, the simultaneous action of hydrochloric and acetic acids are required, the latter producing, it appears, a peculiar, but not well explained, reaction.

**Drying of Woollen Fabrics.**—P. Havrez.—The author states that the complete drying of woollen fabrics is difficult, useless, and injurious to the fibre—difficult, because wool and woollen fabrics attract and retain readily up to 10 per cent of moisture, which should be left in it; useless, because the wool cannot be carded unless moistened and oiled; and injurious, because too strongly-dried wool, as well as woollen fabrics (though in a less degree), become rough and lose suppleness. The author enters, at great length, into the various methods proposed for drying wool and woollen fabrics during the process of manufacture, and describes the stores and drying-rooms to be used.

*Revue des Cours Scientifiques de la France et de l'Etranger*,  
August 6, 1870.

This number does not contain any papers relating to chemistry or sciences allied therewith, but contains an exhaustive and excellent lecture on—

**Natural Selection and the Origin of Man**—Dr. Claparède—And a lecture on the—

**Mechanism of Flying of Birds and Insects.**—Dr. Marey.—Illustrated by a series of woodcuts.

August 13, 1870.

This number does not contain any original papers relating to chemistry or sciences allied therewith, but it contains a most valuable paper on the—

**Value of the Labours of Charles Darwin.**—By no less an authority than the celebrated zoologist, M. Milne-Edwards. And also a paper on—

**Commensalism in the Animal Kingdom.**—M. van Beneden—Wherein the author sets forth several interesting particulars about a very well-known article—viz., sponge—which is a polypous animal reduced to its most simple form; while, chemically, it is a substance very akin to silk—that is to say, a nitrogenous, albuminous compound, almost identical with the fibrine which constitutes more than half the weight of raw silk.

## NOTES AND QUERIES.

**Analyses of Old Yellow Metal.**—Will some of your kind correspondents favour me with the analysis of some samples of old yellow metal taken from ships (*Muntz*), no matter by what maker, but stating, as near as possible, the period during which it had been on the ship, and to what ports the ship had been trading during that period. The information is wanted as accurate as possible, but especially the quantities of copper and spelter. If you will kindly oblige me with this information, through your columns, you will confer a great favour on a very old subscriber.—COPPER. PS. The metal must be thoroughly worn out.

## TO CORRESPONDENTS.

\*\* The STUDENT'S NUMBER of the CHEMICAL NEWS will be published on Friday next, September 9th. Gentlemen holding official positions in the Universities, Medical Schools, &c., of the United Kingdom, where Chemistry and Physical Science form a part of the Education, who have not yet forwarded the necessary information to our office for publication in that number, will confer a favour by sending it with the least possible delay.

A. Hedley.—Forwarded.

R. Galloway.—We are obliged for your kindness.

F. M. Rimmington.—The article will be concluded as soon as possible.

Dr. J. Muter.—Received.

H. N. Draper.—Thanks for your communication; it arrived too late for this week.



# THE CHEMICAL NEWS.

VOL. XXII. No. 563.

(STUDENTS' NUMBER.)

## SCHOOLS OF CHEMISTRY.

### EXAMINING BOARDS.

#### UNIVERSITY OF LONDON.

CANDIDATES for any Degree granted by this University are required to have passed the Matriculation Examination, to which no candidate is admitted unless he has produced a certificate showing that he has completed his sixteenth year.

The Fee for this Examination is £2.

The Examination will be held on Monday, January 4th, 1871, and includes the following subjects:—

#### NATURAL PHILOSOPHY.\*

##### *Mechanics.*—

Composition and Resolution of Statical Forces.

Simple Machines (*Mechanical Powers*):—Ratio of the Power to the Weight in each.

Centre of Gravity.

General Laws of Motion, with the chief Experiments by which they may be illustrated.

Law of the Motion of Falling Bodies.

##### *Hydrostatics, Hydraulics, and Pneumatics.*—

Pressure of Liquids and Gases, its equal diffusion, and variation with the depth.

Specific Gravity, and modes of determining it.

The Barometer, the Syphon, the Common Pump and Forcing-Pump, and the Air-Pump.

##### *Acoustics.*—

Nature of Sound.

Mode and Rate of Propagation of Sound.

Musical Tones.

##### *Optics.*—

Laws of Reflection and Refraction.

Formation of Images by Simple Lenses.

#### CHEMISTRY.

Heat—its sources. Expansion. Thermometers—relations between different Scales in common use. Difference between Temperature and Quantity of Heat. Specific and Latent Heat. Calorimeters. Liquefaction. Ebullition. Evaporation. Conduction. Convection. Radiation.

Chemistry of the Non-Metallic Elements; including their compounds as enumerated below—their chief physical and chemical characters—their preparation—and their characteristic tests.

Oxygen, Hydrogen, Carbon, Nitrogen. Chlorine, Bromine, Iodine, Fluorine. Sulphur, Phosphorus, Silicon.

Combining Proportions by weight and by volume. General Nature of Acids, Bases, and Salts. Symbols and Nomenclature.

The Atmosphere—its constitution; effects of Animal and Vegetable Life upon its composition.

Combustion. Structure and Properties of Flame. Nature and Composition of ordinary Fuel.

Water. Chemical peculiarities of Natural Waters, such as rain-water, river-water, spring-water, sea-water.

Carbonic Acid. Carbonic Oxide. Oxides and Acids of Nitrogen. Ammonia. Olefiant Gas, Marsh Gas, Sulphurous and Sulphuric Acids, Sulphuretted Hydrogen.

\* The knowledge required of these subjects in Natural Philosophy is such as may be attained by attending a course of experimental lectures.

Hydrochloric Acid. Phosphoric Acid and Phosphuretted Hydrogen. Silica.

#### BACHELOR OF SCIENCE (B.Sc.).

This Degree is conferred on candidates who pass a satisfactory examination in Mathematics, Mechanical and Natural Philosophy, Botany, and Vegetable Physiology, Zoology, and Chemistry.

#### FIRST B.Sc. EXAMINATION.

No Candidate (with the exception of such as have obtained Honours at the Matriculation Examination in the preceding January) is admitted to this examination within one academical year of the time of his passing the Matriculation Examination.

The Fee for this Examination is £5.

The examination will commence on Monday, July 18th, 1871. It is conducted by means of printed papers; but the Examiners are not precluded from putting, for the purpose of ascertaining the competence of the Candidates to pass, *vivâ voce* questions to any Candidate in the subjects in which they are appointed to examine.

The First Examination includes the following subjects:—

#### NATURAL PHILOSOPHY.

##### *Heat.*—

Sources of Heat; conduction—convection.

Effects of Heat; expansion generally—of water—of gases and vapours; liquefaction; vaporisation; latent heat; expansive force of steam; dew-point; gases and vapours compared.

Specific Heat.

Thermometers; Pyrometers.

Heat in the Radiant state.

##### *Electricity.*—

Sources of Electricity.

Static Electricity; dual character—insulation—induction—specific inductive capacity—equivalent antithetic states—disruptive discharge—convection; Electroscopes—Leyden Jar, &c.

Dynamic Electricity; Conduction—the electric current—derived currents—induction of currents; Voltaic Pile and other voltaic arrangements.

Thermo-Electricity; Electro-Thermometer.

##### *Magnetism.*—

Magnets, the Earth, &c.; Induction—communication—retention—Magnetic relations of iron, steel, &c.

Electro-Magnetism—as in the spark—in conducting media—in soft iron; Magneto-Electricity; principle of Electro-magnetic and Magneto-electric machines.

Terrestrial Magnetism.

#### INORGANIC CHEMISTRY.

Matter; simple and compound.

Elementary bodies classed. Metallic and Non-Metallic bodies.

Chemical Combination and Mechanical Mixture. Solution.

Outlines of Crystallography. Isomorphism. Dimorphism. Allotropic conditions of matter. Chemical Affinity. Laws of Combination by weight and by volume, as deduced from the history of the individual elements. Equivalent Numbers. Equivalent Volumes. Symbolical Notation, including questions on the Unitary System. Formulæ. Nomenclature.

Chemical actions produced under the influence of Heat. Nature of Combustion. Structure and Properties of Flame. Principles of Illumination. Chemical action of Light. Photography.

Oxygen. Ozone.

Hydrogen. Water.

Nitrogen. Chemical constitution of the Atmosphere. Diffusion of Gases. The Oxides of Nitrogen; Nitric Acid. Ammonia.

Chlorine, Bromine, and Iodine. Their compounds with Oxygen and Hydrogen. Theory of Bleaching.

Fluorine and Hydrofluoric Acid.



Sulphur. Sulphurous Acid. Manufacture and Chemical applications of Sulphuric Acid. Other Oxygen compounds of Sulphur. Sulphuretted Hydrogen.

Phosphorus. Oxygen and Hydrogen compounds of Phosphorus. Theory of Acids. Monobasic, Dibasic, and Tribasic Acids.

Carbon. Carbonic Oxide and Carbonic Acid. The principal Hydrogen compounds of Carbon. Manufacture of Coal Gas.

Silicon and Boron. Their compounds with the elements previously enumerated.

Metals. Characters of Metals as a class. Metallurgical Processes. Alloys. Classification of the Metals.

Potassium. Nitre. Gunpowder. Theory of the action of Gunpowder.

Sodium. Manufacture of Carbonate of Soda.

Barium. Strontium. Calcium. Mortars. Cements.

Magnesium. Aluminium. Glass. Porcelain.

Manganese. Iron. Composition and Properties of Cast-Iron. Wrought-Iron, and Steel. Chromium.

Cobalt. Nickel. Zinc. Cadmium.

Lead. Manufacture of White-Lead.

Copper. Mercury. Bismuth. Tin. Arsenic. Antimony.

Silver. Gold. Platinum.

Principal compounds of the Metals with the Non-Metallic Elements. Theory of Salts.

Principles of Mineral Analysis.

Principles of Electro-Chemistry.

For the First Examination, a knowledge of Inorganic Chemistry only is necessary.

#### EXAMINATION FOR HONOURS.

Candidates for Honours in Chemistry are examined in any of the following subjects, at the option of the Examiners:—

Elementary Substances and their combinations.

Electro-Chemistry.

Radiant Chemical Action.

In the Examination for Honours, the Candidate, being not more than twenty-two years of age, who most distinguishes himself in Chemistry and Natural Philosophy, will receive an Exhibition of Forty pounds per annum for the next two years.

#### SECOND B.Sc. EXAMINATION.

This Examination commences on Monday, October 24th. Candidates for this Examination who have not previously taken the Degree of B.A. is required either to have passed the First B.Sc. Examination at least one Academical year previously, or to have passed the First M.B. Examination, in this University.

The Fee for this Examination is £5.

This Examination embraces Organic Chemistry, including the following subjects:—

Ultimate analysis of Organic bodies. Calculation of Empirical Formulæ. Methods of controlling Empirical Formulæ. Determination of the Equivalents of organic acids and bases; examination of products of Decomposition; determination of the Vapour-density of volatile bodies.

Law of Substitution. Compound Radicals. Homologous Series.

The Chemical History of the Cyanogen group. Cyanogen. Hydrocyanic Acid. Cyanic Acid and Urea. Fulminates. Cyanuric Acid. Sulphocyanic Acid. Chlorides of Cyanogen. Uric Acid.

Amylaceous and Saccharine substances. Fermentation. Alcohol, Wine, Beer, Bread, &c.

Homologues of Alcohol. Ethers, simple and mixed. Oxidation of Alcohol. Aldehyd and Acetic Acid, and their homologues. Anhydrides, simple and mixed. Compound Ethers.

Diatomic Alcohols and their Acids. Glycol and Oxalic Acid and their homologues.

Triatomic Alcohols. Glycerine. Fatty and Oily bodies. Saponification.

Vegetable Acids;—the principal.

Ammonia and its derivatives. Ammonium and Ammoniacal Salts. Amides and Amines; their Classification. The chief natural Organic Bases.

Colouring Matters. Indigo and its derivatives. Principles of Dyeing.

The chief constituents of the Vegetable organism. Cellulose. Vegetable Fibrin. Albumen, Casein, Glutin, &c.

The chief constituents of the Animal organism. Animal Fibrin, Albumen, Casein, Gelatin. Blood, Milk, Bile, Urine, &c.

Decay, Putrefaction. Destructive Distillation.

The Chemical Principles of the process of Nutrition and of Respiration in Plants and Animals.

#### EXAMINATION FOR HONOURS.

The Candidate, not more than twenty-three years of age, who, in the Examination for Honours, most distinguishes himself in Chemistry, will receive Fifty pounds per annum for the next two years, with the title of University Scholar.

#### DOCTOR OF SCIENCE (D.Sc.).

This Examination is held within the first twenty-one days in June, and occupies four days.

No Candidate is admitted to the Examination for the Degree of D.Sc. until after the expiration of two Academical years from the time of his obtaining the Degree of B.Sc. in this University.

Candidates for the Degree of D.Sc. in any year, must give notice of their intention to the Registrar, and pay to him a Fee of Ten pounds, on or before the 1st of April.

Chemical Candidates can be examined either in Inorganic or Organic Chemistry; but no Candidate will be approved by the Examiners unless he has shown a thorough practical knowledge\* of the *Principal Subject*, and a general acquaintance with the *Subsidiary Subject*, or *Subjects*, specified as belonging to the Branch so selected.

#### Inorganic Chemistry.

Principal Subject—Inorganic Chemistry.

Subsidiary Subjects—Either Organic Chemistry; or, Mineralogy, Crystallography, and Chemical Technology in its relations to Inorganic Chemistry.

#### Organic Chemistry.

Principal Subject—Organic Chemistry.

Subsidiary Subjects—Either Inorganic Chemistry; or, Chemical Technology, in its relations to Organic Chemistry, and the Chemistry of Animal and Vegetable Life.

#### EXAMINATIONS IN CONNECTION WITH THE DEPARTMENT OF SCIENCE AND ART, SOUTH KENSINGTON.

A sum of money is voted annually by Parliament for scientific instruction in the United Kingdom.

This sum is administered by the Science and Art Department.

The object of the grant is to promote instruction in Science, especially among the industrial classes, by affording a limited and partial aid or stimulus towards the founding and maintenance of Science schools and classes.

The following are among the Sciences towards instruction in which aid is given:—Acoustics, Light, Heat, Magnetism, and Electricity, Inorganic Chemistry, Organic Chemistry, Geology, Mineralogy, Mining, Metallurgy.

The assistance granted by the Science and Art Department is in the form of—1. Public Examinations, in which Queen's Medals and Queen's Prizes are awarded, held at all places complying with certain conditions. 2. Payments on results to teachers. 3. Scholarships and Exhibitions. 4. Building Grants. 5. Grants towards the purchase of apparatus, &c.

\* It must be understood that the candidate for the Degree of D.Sc. is expected to be so fully conversant with the principal subject he may select, as to be able to go through any examination test (whether theoretical or practical) of his acquirements in it that can be fairly applied.



# CHEMICAL LECTURES AND LABORATORY INSTRUCTION.

## UNIVERSITY COLLEGE.

### FACULTY OF SCIENCE.

Dean.—Professor A. W. Williamson, Ph.D., F.R.S.

Vice-Dean.—Professor G. Croom Robertson, M.A.

Inaugural Lecture, on Tuesday, October 4th, at 3 p.m., by Professor Williamson.

The Session begins on Tuesday, the 4th of October, and ends on Friday, the 23rd of June.

It is divided into three terms, as follows: Michaelmas term, from October 4th until December 21st; Lent term, from January 3rd, 1871, till March 18th; Summer term, for Lectures, from March 20th till June 10th, all inclusive.

Chemistry.—Professor Williamson, Ph.D., F.R.S.

### A. GENERAL COURSE.

Lectures daily, except Saturday, from 11 to 12 a.m.

Exercises on Tuesdays, Wednesdays, Thursdays, and Fridays, from 9 to 10 a.m.

Fee for the Whole Course of Lectures, £6 6s.; for a Half Course, £3 3s.; Perpetual, £9 9s.; for the Organic Course alone, £2 2s.

Fee for the Exercise-Class—For the Course, £2 2s.; for the Half Course, £1 1s.

The Instruction in this Class is of two kinds, consisting partly of Experimental Lectures by the Professor, partly of Exercises and personal instruction on the subject of the Lectures by Tutors, under the direction of the Professor.

The First Half of the Course to Christmas includes those parts of Chemistry which are required for the Matriculation Examination of the University of London.

The Second Half of the Course, extending from January to March, includes the following subjects:—

I. Preparation and properties of the chief metals, including their characteristic reactions and most important salts. Detection of Metallic Poisons. Quantitative Estimation of Metals. Principles of Classification. Monatomic, Diatomic Metals, &c.

A weekly *vivâ voce* examination is held during the First Half Course and the commencement of the Second Half Course.

### II. Organic Chemistry.

This commences in the second week in February, and occupies Five lectures weekly till about the end of March. It includes a study of the characteristics and metamorphoses of the chief organic acids, bases, alcohols, ethers, colouring matters, &c. Methods of ultimate and proximate analysis. Determination of molecular weights. Theory of types; of compound radicals. Phenomena of fermentation, &c.

### Practical Chemistry.

Mondays, Tuesdays, Thursdays, and Fridays, from 12 to 1.

The Course consists of about Forty Lessons, the first twenty being given in the five weeks preceding the Christmas Vacation, the remainder immediately after it.

The First Half includes the portion of Chemistry required for the Matriculation Examination.

For particulars, see the Prospectus of the Summer Session.

Fee for the Course, £4 4s.; Half Course, £2 12s. 6d.

### B. ANALYTICAL AND PRACTICAL CHEMISTRY.

#### I. BIRKBECK LABORATORY.

The instruction in the Laboratory is intended for beginners as well as for more advanced students. It includes practice in the construction and use of apparatus for preparing the common gases, acids, bases, salts, &c., study of the qualitative methods of detecting and separating mineral or organic bodies from one another; also

quantitative analysis in the wet way, organic analyses, vapour-densities, &c.; instruction in gas analysis.

More advanced students are instructed in the methods of original research, especially in organic chemistry.

When accompanied or preceded by attendance on the Lectures on Chemistry, the Laboratory Course qualifies Students in the application of Chemistry to the Manufacturing Arts, Metallurgy, Medicine, or Agriculture, &c. Instruction is given in the principles and processes of Gas Analysis.

The Laboratory and Offices are fitted up completely with the most improved apparatus and utensils for experimental research, both for beginners, and for advanced Students. They are open daily, from 9 a.m. to 4 p.m., from the 4th of October until the end of July, with a short recess at Christmas and at Easter. Saturday, from 9 to 2.

Fees for the Session, 25 guineas; six months, 18 guineas; three months, 10 guineas; one month, 4 guineas; exclusive of the expense of materials. A deduction of about 40 per cent is made for Students who can attend only three fixed days per week.

A Gold Medal and Certificates of Honour are competed for by Students entered for the Session.

### II. SUMMER COURSES.

#### I. Elementary Course.

About Forty Lessons, of one hour each, on Tuesday, Wednesday, Thursday, and Friday, from 11 to 12, commencing in the first week of May. Students are taught the construction and use of apparatus for the preparation of the most important gases, acids, &c. The characteristic tests for the presence of the common acids and bases, including the chief metallic and other poisons. Also the processes for separating these bodies from one another.

Solutions are frequently given in the class for investigation.

The first six weeks of the Course are occupied by the study of the chief non-metallic elements, and their simple compounds. Metallic salts, &c., are subsequently studied.

Fee for the Course, £4 4s., including cost of materials and apparatus.

#### II. Senior Course.

About Ten Lessons, of two hours each, on Mondays, from 10 to 12, commencing in the first week in May. The Course includes tests for fixed and volatile organic acids, nitrogenised acids, sugars, glycerine, &c.: organic bases and alkaloids, constituents of blood, milk, urine, &c.

Volumetric methods of quantitative analysis of acids, alkalies, urea, prussic acid, iron, &c., are practised.

Fee for the Course, £2 2s., including cost of materials and apparatus.

### C. SUMMER MATRICULATION COURSE.

Professor Williamson, F.R.S., assisted by Mr. F. S. Barff, M.A., F.C.S.

This Course includes those parts of Chemistry which are required for the Matriculation Examination of the University of London.

The Course consists of about Twenty Lessons in Practical Chemistry, and of an equal number of Oral Lessons. The Practical Lessons include the preparation of the common gases and acids, &c., and the study of their characteristic properties in relation to the elementary laws of combination.

The other lessons are chiefly devoted to those parts of the subject which require fuller oral explanation than is given in the practical lessons. They include numerous exercises and questions, to which answers in writing are given by the Students. These Lessons will begin on Wednesday, April 5th, at 11 a.m.

The Class will meet on the first five week days, from 11 to 12; and some other Meetings will be announced when the Class has assembled.

Fee for the Class, £4 4s., including cost of materials and apparatus.



## EVENING CLASSES.

The Session is divided into three Terms, each of ten complete weeks, exclusive of vacations—

I. The Michaelmas Term, beginning on Monday, the 10th of October, and ending on Thursday, December 15th.

II. The Lent Term, beginning on Monday the 9th of January, and ending on Thursday, March 16th.

III. The Summer Term, beginning on Monday, the 20th of March, and ending on Thursday, June 8th; the Easter Vacation extending from the 6th to the 17th of April, both days inclusive.

The object of these Classes is to extend the benefits of the College Tuition especially to gentlemen engaged elsewhere during the day, and to provide Instruction in subjects not taught in the ordinary College Classes.

The Beadles have orders to admit gentlemen to any of the Classes, with the permission of the Professor or Teacher, as occasional visitors.

The Library is open for the convenience of the Students between 6.30 and 8.30 on the evenings when the Classes meet, except when it is wanted for other purposes.

*Elementary Chemistry—Theoretical and Practical.*

Professor Williamson, F.R.S., and Mr. Jones. Monday, from 7.30 to 9.30.

A Course of Twenty Lessons, of two hours each, in the Michaelmas and Lent Terms.

The elements of Chemistry are explained to the Class, and the experiments illustrating the subject are performed by the Students.

The subject will be the common Non-Metallic Elements and the common Metals, their Compounds and chief Properties, and the best methods of distinguishing and separating them.

All the experiments and analyses are repeated by each Student, or by not more than two Students jointly.

Fee, including the cost of materials, &c., £2 2s. per Term.

## ROYAL SCHOOL OF MINES AND COLLEGE OF CHEMISTRY.

*Professor of Chemistry.*—Dr. E. Frankland, F.R.S.

The instruction in Chemical Science embraces:—

1. A course of Lectures on Experimental Chemistry, with special reference to the applications of Chemistry in the Arts and Manufactures.

2. A systematic Laboratory Course for the Practice of Chemical Analysis.

*Chemical Lectures.*—The Course consists of Forty Lectures on Mineral Chemistry and Thirty Lectures on Organic Chemistry.

The Lectures are delivered at the Royal College of Chemistry, Oxford Street.

*Chemical Laboratory.*—The general Laboratory for instruction in chemical manipulation, in qualitative and quantitative analysis, and in the method of performing chemical researches, is under the direction of Dr. Frankland, and will be opened on Monday the 3rd of October, 1870. The Royal College of Chemistry having become the property of the Government, its Laboratories are used for the instruction of the pupils of the Royal School of Mines.

There are three terms in the collegiate year, of three months each, commencing in the first week of October, January, and April respectively. The Laboratory hours are from 10 a.m. to 5 p.m., with the exception of Saturdays, when the Laboratory closes at 2 o'clock.

Each Laboratory Student works independently, there being no classes. All operations are superintended by the Professor and his assistants. A table with drawers, cupboards, and shelves, is appropriated to every pupil. The Institution supplies gas, fuel, and reagents. The larger and more expensive instruments of the Laboratory, such as air-pumps, thermometers, barometers, condensers, &c., may be used by the students, who are held responsible for their safety. The students have to pro-

vide themselves only with the apparatus specified in the Laboratory regulations. More advanced students engaged in private researches have to supply themselves with such materials as are not included amongst the ordinary reagents of the Laboratory.

*Professor of Metallurgy.*—Dr. Percy, F.R.S.

The course of instruction in Metallurgy consists of Lectures and Laboratory practice.

The object of the Lectures is the communication of such instruction as the student may be able to apply to the greatest practical advantage, when he may be subsequently engaged in conducting any metallurgical process.

*Metallurgical Laboratory.*—This Laboratory is conducted by Mr. R. Smith, under the direction of Dr. Percy, and is devoted to practical instruction in Metallurgy. It will be opened on the 3rd of October, 1870. The nature of this instruction will be adapted to the special requirements of the Students. It comprises:—Assaying in all its branches, especially of the more important metals, such as iron, copper, lead, tin, alloys of silver and gold, &c., and the examination of ores and metallurgical products.

The ability of the student to make trustworthy assays is in every case thoroughly tested; and no certificate of competency is given to a student who has not furnished satisfactory proof that he is able to obtain accurate results.

There are three terms in the collegiate year, of three months each. The Laboratory hours are from 10 to 4 during November, December, January, and February; and from 10 to 5 during the other months, with the exception of Saturdays, when the Laboratory is closed.

The charge for instruction in the Metallurgical Laboratory is £15 for three months; £12 for two months; and £7 for one month.

*Evening Lectures.*—This year these lectures will consist of two courses of eight lectures each. Subjects—Chemistry and Natural Philosophy.

## KING'S COLLEGE.

*Professor of Chemistry.*—W. A. Miller, M.D., V.P.R.S.

*Professor of Practical Chemistry.*—C. L. Bloxam.

Students of the first and second years are admitted to the Course of Theoretical and Applied Chemistry. The Course commences with a view of the forces which concur to the production of Chemical Phenomena, after which the laws of Chemical Attraction are discussed, and the Non-metallic Elements and their principal compounds are described.

The metals and their principal compounds are next examined, care being taken to point out the applications of the Science to the Arts, and the processes of the different Manufactures of Metallurgy, and of Domestic Economy, are explained and illustrated.

Examinations of the Class, both *vivâ voce* and by written papers, are held at intervals during the course at the usual Lecture hour. Dr. Miller has published a work on Chemistry, which is used as a text-book by the class.

*Third Year.*—Students who have completed six Terms in this Department are admitted to a Course of "Practical Chemistry," consisting of Twelve Demonstrations in each term; and they go through a course of Manipulation in the most important operations of Chemistry, including the first steps of Analysis.

Any Student of this department may be admitted to this Class at any period of his study, on payment of an extra fee.

*Experimental and Analytical Chemistry in the Laboratory.*—The object of this Class is to afford to Students who are desirous of acquiring a knowledge of analysis, or of prosecuting original research, an opportunity of doing so under the superintendence of the Professor and Demonstrator; Students may enter, upon payment of the extra fees, at any time except during the vacation, and for a period of one, three, six, or nine months, as may best suit their convenience. The laboratory hours are from ten till four daily, except Saturday, on which day the hours are from ten till one.



In addition to the Laboratory fee, each Student defrays the expenses of his own Experiments. The amount of this expense, which is comparatively trifling, is entirely under his own control.

*Analytical and Experimental Chemistry.*—Besides the Course of Chemical Lectures and the Summer Class of Practical Chemistry, provision is made for those Students who wish to become more minutely acquainted with the practical details of the Science. By means of this Class each Student is enabled to familiarise himself with the methods of analysis and research. After passing through a preliminary course of analytical operations, each Student devotes himself to such portions of the science as are most interesting to himself, or most likely to be practically useful to him. The Daniell Scholarship of £20, tenable for two years, is given every alternate year for original research in the Laboratory.

The Fees for admission to the Laboratory Class, exclusive of materials, are, for one month, £4 4s.; for three months, £10 10s.; for six months, £18 18s., &c.

#### EVENING CLASSES.

Classes for Evening Instruction are held at King's College from October to March, and during April, May, and June.

The Classes include one for the Elements of Chemistry and one for Practical Chemistry.

The fee for the former is £1 11s. 6d.; for the latter, £2 2s. The Classes meet twice a week.

#### PHARMACEUTICAL SOCIETY OF GREAT BRITAIN.

17, BLOOMSBURY SQUARE, W.C.

School of Pharmacy. The Session (1870-71) will commence on Monday, October 3rd, and extend to the end of July.

LECTURES ON CHEMISTRY AND PHARMACY, BY DR. REDWOOD.

These Lectures will be delivered on Monday, Tuesday, and Wednesday mornings, at 9 o'clock.

Part 1.—Physics in relation to Chemistry and Pharmacy.

„ 2.—Chemistry of Inorganic Bodies.

„ 3.—Chemistry of Organic Bodies.

Also Lectures on Botany and Materia Medica, by Professor Bentley. The first and second parts of this course, extending over the winter months, will be delivered at 17, Bloomsbury Square, on Friday and Saturday mornings, at 9 a.m. The third part of the course, on Systematic Botany, will be delivered at the Royal Botanic Gardens, Regent's Park, at 8 a.m.

*Fees.*—For registered apprentices and associates of the Society, for either of the above courses, £1 1s.; for either part separately, 10s. 6d. For those not connected with the Society, £2 2s. for either of the above courses; £1 1s. for either part separately. Students have free admission to the Library and Museum.

*Laboratory.*—The suite of Laboratories for Practical Instruction in General and Pharmaceutical Chemistry will be opened on Monday, the 3rd of October, under the direction of Professor Atfield, Ph.D. Fee for the entire session of ten months, Twenty-five Guineas. The Laboratories are open from 9.30 a.m. till 5 p.m. Students can enter at any period during the session.

*Two Scholarships* (the Jacob Bell Memorial Scholarship) of Thirty Pounds a year each, are open to competition annually in July.

The Board of Examiners meet monthly, and are required by the Pharmacy Act to examine "all candidates who may present themselves for examination in their knowledge of the Latin Language, in Botany, in Materia Medica, in Pharmaceutical and General Chemistry, and to grant Certificates of Competency."

#### LADIES' MEDICAL COLLEGE.

The Ladies' Medical College, established by the Female Medical Society in order to teach to educated

women the theory and practice of Midwifery and the accessory branches of medicine.

*President*—Lord Shaftesbury.

*Hon. Sec.*—Dr. James Edmunds.

The Seventh Annual Session will commence on Oct. 3, 1870, and extend to April, 1871, with a vacation of two weeks at Christmas.

The Lectures will occupy the afternoons of the Mondays, Tuesdays, Wednesdays, and Fridays, from 3 o'clock till 5.

*Elementary Materia Medica.*—(Teachership now vacant).

*Elementary Chemistry.*—Mr. J. R. Newlands.

Fee for two sessions' attendance upon the Lectures on Midwifery, Anatomy, and Physiology, Medical Science, and Hygiene, £10 10s.

Fee for each of the Extra Courses, one session, £1 1s.; two sessions, £1 11s. 6d.

Further details as to the objects and operations of the Society, and prospectuses of the College, may be obtained by letter to the Lady Secretary, 164, Great Portland Street, W.; or from the Hon. Sec., 4, Fitzroy Square, W.

#### CITY OF LONDON COLLEGE, LEADENHALL STREET, E.C.

The Annual Courses consist of three terms, each averaging ten experimental lectures: fee, 5s. per term. Subjects:—Junior Class, Chemistry—first year, Non-Metals; second year, Metals and (time permitting) Elements of Organic Chemistry. Senior class, 7 to 8 p.m., Practical Analysis.

#### BIRKBECK LITERARY AND SCIENTIFIC INSTITUTION.

##### EVENING CLASSES.

*Chemistry.*—Mr. G. Chaloner. Tuesday, 8 to 9.

#### NEW KENNINGTON INSTITUTE.

Evening Lectures and Practical Classes in Chemistry, Pharmacy, and all subjects connected with the Pharmaceutical Examinations, under the direction of Dr. Mutter.

#### POLYTECHNIC INSTITUTION.

Course of Thirty Lessons in Inorganic Chemistry, under the superintendence of Professor Pepper. Tuesday, 8.30 to 10 p.m.

#### ROYAL VETERINARY COLLEGE, CAMDEN TOWN.

*Chemical Professor.*—Mr. R. V. Tuson.

#### LECTURES AT LONDON MEDICAL SCHOOLS.

#### ST. BARTHOLOMEW'S HOSPITAL & MEDICAL COLLEGE.

##### WINTER SESSION.

*Lecturer.*—Dr. Matthiessen, F.R.S. Monday, Wednesday, and Friday, at 9.15 a.m. One Course, £5 5s.

##### SUMMER SESSION.

*Practical Chemistry.*—Dr. Matthiessen, F.R.S. One course, £2 2s.

#### CHARING CROSS HOSPITAL AND COLLEGE.

##### WINTER SESSION.

*Lecturer.*—Mr. C. W. Heaton, F.C.S. Monday, Thursday, and Friday, at 11. One session, £5 5s.

The Laboratory is open daily.

##### SUMMER SESSION.

*Practical Chemistry.*—Mr. Heaton, F.C.S. Monday and Friday. One session, £2 2s.



## ST. GEORGE'S HOSPITAL.

## WINTER SESSION.

*Lecturer.*—Dr. H. M. Noad, F.R.S. Tuesday, Thursday, and Saturday, at 11.30. One course, £6 6s.

## SUMMER SESSION.

*Practical Chemistry.*—Dr. Noad, F.R.S. Monday, Wednesday, Thursday, Friday, at 10. One course, including the use of apparatus and materials, £4 4s.

## GUY'S HOSPITAL.

## WINTER SESSION.

*Lecturers.*—Dr. Debus, F.R.S., and Dr. Stevenson. Tuesday, Thursday, and Saturday, at 11. One course, £4 4s.

## SUMMER SESSION.

*Practical Chemistry.*—Dr. Debus, F.R.S. Monday, Wednesday, and Friday, from 10 to 1. One course, £4 4.

## LONDON HOSPITAL.

*Lecturers on Chemistry.*—Henry Letheby, M.B., and C. Meymott Tidy, M.B. Monday, Wednesday, and Friday, at 10.30 a.m.

*Practical Chemistry.*—Dr. Letheby, M.B. Monday, Tuesday, and Saturday, at 9 a.m.

## ST. MARY'S HOSPITAL.

## WINTER SESSION.

*Lecturer.*—Dr. W. J. Russell, F.C.S. Monday, Tuesday, Thursday, and Friday, at 10.15. £5 5s.

## SUMMER SESSION.

*Practical Chemistry.*—Dr. W. J. Russell, F.C.S. Tuesday and Thursday, at 11.30 a.m.; and Saturday, at 9 a.m. One session, £3 3s.

## MIDDLESEX HOSPITAL.

## WINTER SESSION.

*Lecturers.*—Mr. Taylor and Mr. Heisch. Monday, Wednesday, Friday, and Saturday, at 11. One session, £6 6s.

## SUMMER SESSION.

*Practical Chemistry.*—Mr. Taylor and Mr. Heisch, Monday, Wednesday, and Friday, at 11. One session, £3 3s.

## ST. THOMAS'S HOSPITAL.

## WINTER SESSION.

*Lecturer.*—Dr. A. J. Bernays. Wednesday, Thursday, and Friday, at 9. One course, £5 5s.

## SUMMER SESSION.

*Practical Chemistry.*—Dr. A. J. Bernays. Tuesday and Thursday, 10 to 12; Friday, 11; Saturday, 10 to 1. One course, £3 3s.

## WESTMINSTER HOSPITAL.

## WINTER SESSION.

*Lecturer.*—Dr. A. Dupré, F.C.S. Tuesday and Thursday, at 3 p.m.; Friday, at 3.30 p.m. One course, £5.

## SUMMER SESSION.

*Practical Chemistry.*—Dr. A. Dupré, F.C.S. Tuesday and Thursday, at 10 a.m. One course, £2.

## PRIVATE TEACHERS OF CHEMISTRY IN LONDON.

*Mr. J. C. Braithwaite*, 54, Kentish Town Road, N.W.—Chemistry and Toxicology, Monday and Thursday; Latin, Tuesday and Friday; Botany and Materia Medica, Wednesday and Saturday. All the classes commence at 8 p.m. Laboratory and Botanic Garden open daily, except Saturdays.

*Mr. Henry Matthews*, F.C.S.—Laboratory, 60, Gower Street, Bedford Square. Instruction in all branches of Practical Chemistry, particularly in its application to

Medicine, Agriculture, and Commerce. Laboratory open daily, except Saturday, from 10 to 5; on Saturday, from 10 to 1.

*Dr. John Muter*, M.A.—Laboratory, 289, Kennington Road. Prepares for examinations of Pharmaceutical Society.

*Mr. John Newlands*, F.C.S.—Laboratory, 13, Knowle Road, Brixton, S.W. Gives practical instruction in Analysis, and prepares gentlemen for various public examinations.

*Mr. A. Vacher*, 20, Great Marlborough Street, Regent Street.

## UNIVERSITY OF OXFORD.

*Professor of Chemistry.*—Sir B. C. Brodie, Bart., M.A., F.R.S.

*Demonstrator.*—E. Madan, M.A.

A commodious Laboratory is attached to the New Museum.

Scholarships of about the value of £75 are obtainable at Christ Church, Magdalen, and other Colleges, by competitive examination in Natural Science.

## UNIVERSITY OF CAMBRIDGE.

*Professor of Chemistry.*—G. D. Liveing, M.A.

## MICHAELMAS TERM.

Practical Chemistry, by the Professor, on Mondays, Wednesdays, and Fridays, at 1 p.m.

## LENT TERM.

Chemistry, by the Professor, on Mondays, Wednesdays, and Fridays, at 12.

Practical Chemistry, on the same days, at 1 p.m.

## EASTER TERM.

Chemistry, by the Professor, on Mondays, Wednesdays, and Fridays, at 12.

Practical Chemistry, on the same days, at 1 p.m.

The Chemical Laboratory of the University is open daily, from 10 a.m. till 6 p.m.; so that Students can work there at such times as may be convenient to them; and the Professor will attend to give instruction at the times above specified.

## PROVINCIAL SCHOOLS.

## BIRMINGHAM.—MIDLAND INSTITUTE.

*Lecturer on Chemistry.*—Mr. C. J. Woodward, B.Sc. Tuesday and Thursday, at 8 p.m.

*Practical Chemistry.*—Mr. C. J. Woodward, B.Sc. Saturday, 3 to 6, and 6.30 to 9.30 p.m.

## BIRMINGHAM.—QUEEN'S COLLEGE.

## WINTER SESSION.

*Professor of Chemistry.*—Alfred Hill, M.D., Borough Analyst. Tuesday, Thursday, and Friday, at 12.

## SUMMER SESSION.

*Practical Chemistry.*—Professor A. Anderson. Thursday and Friday, at 2 p.m.

## BIRMINGHAM.—KING EDWARD VI. GRAMMAR SCHOOL.

*Teacher of Chemistry.*—G. Gore, F.R.S.

*Assistant Teacher of Chemistry.*—J. G. Grenfell, B.A.

## BRISTOL.—BRISTOL MEDICAL SCHOOL.

## WINTER SESSION.

*Lecturer.*—Mr. Thomas Coomber, F.C.S. Monday, Tuesday, Wednesday, and Thursday, at 8.15. One Course, £5 5s.

## SUMMER SESSION.

*Practical Chemistry.*—M. T. Coomber, F.C.S. Daily, except Saturday, at 8 a.m. One course, £3 3s.



ROYAL AGRICULTURAL COLLEGE,  
CIRENCESTER.

*Principal*.—Rev. J. Constable, M.A.

*Professors*.

*Agriculture*.—J. Wrightson, F.C.S., M.R.Ag.Coll.

*Chemistry*.—A. H. Church, M.A.

*Chemical Assistant*.—E. Kinch.

*Natural History*.—W. R. McNab, M.D.

*Veterinary Surgery*.—J. McBride, M.R.C.V.S.

*Surveying*.—The Principal.

*Drawing*.—J. Miller.

Three courses of Lectures on Chemistry are being delivered during the present session, which commenced August 15th.

Agricultural Chemistry, on Thursdays at 10.

Organic Chemistry, on Tuesdays and Wednesdays, at 9.

Inorganic Chemistry, on Mondays at 9, and Tuesdays at 2.

There are also three classes for the study of practical chemistry. Students occupy themselves with Chemical Manipulation during the first session, Qualitative Analysis during the second, and Quantitative Analysis during the third. The Laboratory of the College is open from 9 a.m. to 5 p.m. In the Private Laboratory of the Professor of Chemistry researches and analysis, relating chiefly to Agricultural Chemistry, are carried on.

*Text Books*.—Church's "Laboratory Guide" (2nd edition) "How Crops Grow" (Church and Dyer's edition), Fownes's "Chemistry," Anderson's "Agricultural Chemistry."

LIVERPOOL ROYAL INFIRMARY SCHOOL OF  
MEDICINE.

WINTER SESSION.

*Chemical Lecturer*.—Mr. J. C. Brown, B.Sc., F.C.S.

Monday, Tuesday, Thursday, and Friday, at 10.15. One course, £5 5s.

SUMMER SESSION.

*Practical Chemistry*.—Mr. J. C. Brown, B.Sc., F.C.S.

Tuesday, Wednesday, and Thursday, at 10.30. One course, £3 3s.

The Laboratory is open daily, from 10 to 4.

ANALYTICAL LABORATORY AND SCHOOL OF  
TECHNICAL CHEMISTRY,

7, IRWELL CHAMBERS, FAZUCKERLY STREET, OLD HALL  
STREET, LIVERPOOL.

Conducted by Mr. A. Norman Tate.

Pupils may attend at any time between the hours of 9.30 a.m., and 5 p.m. (Saturdays, 9.30 a.m. and 1 p.m.), and may work every day, or any numbers of days, or portion of a day in the week, and for any period most convenient to themselves.

The Laboratory is also open two evenings per week for practical work.

Lectures one evening each week.

A separate working bench is provided for each Student, and he is also supplied with all ordinary chemicals, gas, fuel, and the more substantial portions of Laboratory apparatus, but must provide himself with test-tubes, beakers, and other apparatus of a fragile nature.

In addition to the ordinary chemical studies, the course of instruction will, as far as possible, comprise all such studies as may be required for the successful prosecution of the particular branch or branches of Applied Chemistry in which the pupil is to engage; as, for example, in the case of one intended for manufacturing pursuits, he would study architectural and mechanical drawing, so far as is required for the preparation of plans, &c., of chemical apparatus and manufactories, the nature and use of building materials, and the scientific principles and practical rules involved in building and constructive operations, and other scientific and practical information required in the arrangement, construction, and management of chemical manufactories, and the application of Chemistry to industrial pursuits.

COLLEGE OF CHEMISTRY, LIVERPOOL.

*Principal*.—Dr. Sheridan Muspratt, F.R.S.E., M.R.I.A., F.C.S., &c.

*Assistant*.—Mr. Martin Murphy, F.C.S.

The Course of Instruction in this College is entirely devoted to Laboratory work. The term is three months, and dates from time of entrance. Fee for working six days per week, £12 12s.; five days, £11 11s.; four days, £10 10s.; three days, £9 9s.; two days, £8 8s.; and one day per week, £6 6s. Hours of attendance, from 10 a.m. till 5 p.m. The Students' laboratories close at 1 p.m. on Saturdays.

Medical students may enter for one hour per day per session. Fee, £3 3s.

Certificates of attendance recognised by the University and Apothecaries' Hall of London, and Apothecaries' Hall of Ireland.

LEEDS SCHOOL OF MEDICINE.

WINTER SESSION.

*Lecturer*.—Mr. J. Chapman Wilson, F.C.S.

Daily, except Saturday, at 11 a.m. One course, £4 4s.

SUMMER SESSION.

*Practical Chemistry*.—Mr. Wilson, F.C.S.

Tuesdays and Thursdays, 11 to 12.30. One course, £2 2s.

LEEDS MECHANICS' INSTITUTION AND  
LITERARY SOCIETY'S LABORATORY.

SESSION 1870-71.

Chemical Classes for Instruction in Elementary, Practical, and Analytical Chemistry.

*Teacher*.—Mr. George Ward, F.C.S.

The usual Sessional Course of Instruction in abstract and Applied Chemistry will commence on Thursday, September 22nd, at 8 p.m., on which evening the teacher of the classes will deliver an Introductory Lecture.

Fees, payable in advance:—Elementary Chemistry, Thursday, per session, £1 15s.; or 5s. 6d. per month. The subscription includes a selection of apparatus and material specially adapted for the course of instruction. To pupils providing their own materials, £1 1s. per session. Organic Chemistry, Friday, per session, 10s. 6d. Practical Chemistry, Tuesday, per session, £1 1s.; or 3s. 6d. per month, including apparatus and material. The session extends over seven months, from October to April inclusive.

HIGH HARROGATE COLLEGE, YORKSHIRE.

*Professor of Chemistry*.—Mr. W. G. Mason, F.C.S., Certificated Science Teacher.

MANCHESTER GRAMMAR SCHOOL.

DEPARTMENT OF MATHEMATICS AND PHYSICAL SCIENCE.

*Masters*.—T. S. Aldis, M.A. (Cantab.) W. M. Watts, D.Sc. (Lond.); J. Angell, Esq., and S. Edwards, B.A.

There is a large Chemical Laboratory attached to the School, and Chemistry and the various branches of Physics are regularly taught. Arrangements can be made for students to devote their whole time to Physical Science and Mathematics.

MANCHESTER ROYAL SCHOOL OF MEDICINE.

*Lecturer on Chemistry*.—Mr. Daniel Stone.

The usual course for the Medical Boards.

A Laboratory is connected with the school.

OWEN'S COLLEGE, MANCHESTER.

(IN CONNECTION WITH THE UNIVERSITY OF LONDON).

*Chemistry*.—Professor H. E. Roscoe, B.A., Ph.D., F.R.S., F.C.S.

*Junior Class*.—Wednesday and Saturday, from 9.15 to 10.15 a.m.

Subject: Inorganic Chemistry, comprising the laws of chemical combination, and a description of the properties



and mode of preparation of the non-metallic elementary bodies and their most important compounds.

*Senior Class.*—Tuesday and Thursday, from 9.15 to 10.15 a.m.

Subjects: Inorganic and Organic Chemistry, including the properties of the metals and their compounds, and the composition and relations of the best defined groups of organic bodies, and the laws regulating their formation.

Students are expected to answer the written exercises and attend the *viva voce* examinations given in these classes.

Fee, for each class, £3 3s. For both classes, £5 5s.

A *Recapitulatory Lecture*, without additional Fee, will be given on Friday at 9.15 a.m., which members of both classes will be required to attend.

*Extra Class.*—Wednesday, from four to five p.m.

Subject: Technological Chemistry.

The Chemical Principles involved in the most important Chemical Manufactures will be chiefly considered in this course.

Students attending this class must be acquainted with the principles of Chemical Science. Fee, £2 2s.

#### *Analytical and Practical Chemistry.*

##### LABORATORY COURSE.

*Professor.*—Henry E. Roscoe, B.A., Ph.D., F.R.S.

*Senior Assistant.*—Mr. C. Schorlemmer, F.C.S.

The aim of this course is to make the student practically acquainted with Chemical Science, to enable him to conduct analysis and original research, and to fit him for applying the science to the higher branches of Art, Manufactures, and Agriculture. To accomplish this, an attendance of not less than four days per week during three whole sessions is as a rule necessary. It is very advisable that each Laboratory Student should attend or should have attended the course of Lectures on Theoretical Chemistry.

The College Laboratory will be open for students daily from 10.30 a.m. until 5 p.m., except Saturdays, when it will be closed at 1.30. The Laboratory is closed from 1.15 until 2, for dinner.

The Laboratory is fitted with every convenience for the prosecution of practical chemistry, all branches of qualitative and quantitative analysis, and original research.

Each student is provided with a separate working table, set of tests, fuel, water, and gas, free of expense; but he is required to find his own apparatus, a few of the more expensive reagents, and the chemicals required for his experiments. Other apparatus or instruments of a more expensive description may be obtained on loan from the Laboratory Steward, subject to regulations to be prescribed by the Professor.

*Fees for the Session.*—Students working six days per week, £21; ditto, four days, £17 17s.; ditto, three days, £13 13s.; ditto, two days, £9 9s.; ditto, one day, £5 5s. Students entering the Laboratory Class at or after Christmas, for not less than two days per week, will be charged two-thirds of the fees for the whole session.

*Special Fees for Shorter Periods.*—For six months, six days per week, £17 17s.; five months, ditto, £15 15s.; four months, ditto, £13 13s.; three months, ditto, £10 10s.; two months, ditto, £7 7s.; one month, ditto, £4 4s.

Lectures on the methods of Qualitative and Quantitative Analysis, intended to supplement the instruction in Practical Chemistry, will be given by Mr. Schorlemmer, on Mondays, from 4 to 5 p.m.

First year's Laboratory Students are recommended to attend and answer the written exercises and the *viva voce* questions given in this class. Fee, £1 11s. 6d.

*Chemical Calculations.*—In this class, instruction and special practice is given, by Mr. Schorlemmer, on Wednesday, from 4 to 5 p.m., in the methods of Chemical Calculations, serving as supplementary to the Lecture and Laboratory Courses. Fee, £1 1s.

The Lectures on Chemistry in Owen's College are recognised by the University of London for its Medical

Degree, by the Royal College of Surgeons, and by the Apothecaries' Hall.

##### EVENING CLASSES.

##### *Chemistry.*

Professor H. E. Roscoe, B.A., Ph.D., F.R.S.

*Lecture Class* (First Course—The Non-Metallic Elements).—Monday, from 8.35 to 9.35 p.m.

*Lecture Class*—(Second Course—The Metals). Friday, from 8.35 to 9.35 p.m.

*Lecture Class* (Third Course—Organic Chemistry).—Mr. C. Schorlemmer, F.C.S. Thursday from 8.35 to 9.35 p.m.

##### *Laboratory Courses of Practical Chemistry.*

Professor Roscoe, F.R.S., and Mr. Schorlemmer, F.C.S.

*Junior and Senior Divisions.*—Monday, from 6 to 8.30 p.m.

*Pharmaceutical Course.*—Monday and Wednesday.

##### COLLEGE OF MEDICINE, NEWCASTLE.

(IN CONNECTION WITH THE UNIVERSITY OF DURHAM).

*Education in Pharmacy.*—The Council of the College have added a Lectureship on Pharmacy to those at present existing. The proposed curriculum for Students in Pharmacy will consist of attendance on Lectures on Botany, Materia Medica, Chemistry, and Pharmacy. The Lectures on the two former of these subjects will be delivered in the summer, and those on the two latter in the winter session of study.

*Lecturer on Chemistry.*—Mr. A. Freire-Marreco.

Monday, Wednesday, Thursday, and Friday, at 4 p.m.

##### EVENING COURSES.

*Chemical Physics.*—Every Monday, at 7.30 p.m.

*Inorganic Chemistry.*—Every Wednesday, at 7.30 p.m.

*Practical Pharmacy.*—B. S. Proctor. Every Tuesday, at 7.30 p.m.

This course will include—General Processes and Physics applied to Pharmacy—Pharmacopœial Processes, and the most important recent improvements in Pharmaceutical preparations—Dispensing operations—Testing and the Test Solutions of the Pharmacopœia. The course will be illustrated, whenever practicable, with apparatus, experiments, and processes in operation.

*Practice of Chemistry.*—The Laboratories are open daily throughout the year from 10 to 5 o'clock. Non-Medical students can attend Laboratory practice and receive Instruction in Analysis.

Students attending the Laboratory practice and Lectures on Chemistry, who have passed the Durham Registration Examination, or any Examination in Arts recognised as its equivalent, will be registered on the books of the College as Students in Chemistry.

*Fees.*—Perpetual ticket for Pharmacy Curriculum, £6 6s. (this applies only to Students at present engaged in Pharmacy, and who enter before October, 1871). Separate Courses of Lectures (each), £4 4s. Laboratory Practice, 6 days per week, £31 10s. per annum; 4 days per week, £21 per annum. Special arrangements for shorter attendances. These fees admit to all the Courses in Chemistry.

##### SHEFFIELD.

Mr. W. Baker, F.C.S. Laboratory for Theoretical and Practical Chemistry, 46, High Street, Sheffield.

##### SCHOOL OF CHEMISTRY,

1, SURREY STREET, SHEFFIELD.

Mr. A. H. Allen, F.C.S., delivers a Course of Thirty Lectures on Inorganic Chemistry, in connection with the Science and Art Department.

Day and Evening Classes for Analytical Chemistry.

##### SHEFFIELD SCHOOL OF MEDICINE.

During the Winter Session, Mr. A. H. Allen, F.C.S., will deliver a Course of Forty-five Lectures on Chemistry.



## SCOTLAND.

### UNIVERSITY OF EDINBURGH.

*Professor of Chemistry.*—Dr. A. Crum Brown, F.R.S.

### ROYAL COLLEGE OF PHYSICIANS AND SURGEONS, EDINBURGH.

*Lecturer on Chemistry.*—Dr. Stevenson Macadam, F.R.S.E.

The Courses of Instruction in Chemistry include its applications to Medicine, Agriculture, and the Industrial Arts; and they qualify for the University of Edinburgh and other Universities, the Royal Colleges of Physicians and Surgeons, the Navy, Army, and Indian Medical Service, and the other Medical and Public Boards.

The Lectures on Chemistry commence on Wednesday, November 2nd, and continue to be delivered daily during the five months of the Winter Session. The Lectures form a complete Course; the New Nomenclature and Notation are employed throughout, and special Lectures in Technological Chemistry are given. Tutorial Class Examinations are held during the Session, and Excursions are arranged for visiting the principal Chemical Manufactories.

The Instructions in Analytical Chemistry are conducted in the laboratories at Surgeons' Hall, which are now open daily, under the personal superintendence of Dr. Macadam, for the instruction of gentlemen in Chemical Analysis, and the prosecution of researches in Manipulative Chemistry.

The Prelections in Practical Chemistry are also conducted in the Laboratories at Surgeons' Hall. The subjects selected for Examination are those with which Medical Students are specially called upon to exhibit a practical acquaintance.

*Fees.*—Lecture, £3 5s. (University Graduation, £4 4s.) Practical Chemistry (University, &c.), £3 3s.; Analytical Chemistry, £2 per month, £5 for three months, or £10 for six months.

### UNIVERSITY OF GLASGOW.

*Professor of Chemistry and Practical Chemistry.*—Dr. Thomas Anderson, F.R.S.E.

### ANDERSONIAN UNIVERSITY, GLASGOW.

*Professor of Scientific Chemistry.*—Dr. T. E. Thorpe.

### GLASGOW MECHANICS' INSTITUTION.

*Professor of Chemistry and Practical Chemistry.*—Dr. R. Carter Moffat.

*Assistants.*—Mr. Marshall and Mr. D. Swan.

1. Course of Lectures on Chemistry for Medical Students, Manufacturers, Agriculturists, and others. Daily at 12; beginning October 26, and terminating in April.

The design of this Course, which comprises more than one hundred Lectures, is to instruct the Student in the Departments of Scientific Chemistry, and the application of its principles to Manufactures, Medicine, &c. Certificates of attendance on these Lectures are received by the Royal College of Physicians of London and Edinburgh, by the Royal Colleges of Surgeons of England, Ireland, and Edinburgh, by the Faculty of Physicians and Surgeons of Glasgow, by the Army, Navy, and East India Boards, and by the Apothecaries' Halls; they also qualify for graduation in the University of London, &c.

2. Instruction in the various Departments of Practical and Analytical Chemistry in the Laboratories, from 10 till 4.

3. Evening Course of Popular Lectures on General Chemistry, on Tuesdays at 8.30. Practical class in connection at 7.

4. Evening Classes for Technical Chemistry, on Monday, Wednesdays, and Fridays.

5. Practical Classes for Medical Students, daily in the Laboratory, at 10.

6. Summer Course of Practical Chemistry for Medical Students, commencing May 2, 1871, at 11.

### GLASGOW VETERINARY COLLEGE.

*Professor of Chemistry.*—Dr. R. Carter Moffat.

## IRELAND.

### DUBLIN.—TRINITY COLLEGE,

*Professor of Chemistry.*—Dr. Apjohn, F.C.S.

### ROYAL COLLEGE OF SURGEONS, DUBLIN.

*Professor of Chemistry.*—Dr. Barker.

### QUEEN'S COLLEGE BELFAST.

*Professor of Chemistry.*—Dr. Andrews, F.R.S., &c.

### QUEEN'S COLLEGE, CORK.

*Professor of Chemistry.*—Dr. Blyth.

### QUEEN'S COLLEGE, GALWAY.

*Professor of Chemistry.*—Dr. T. H. Rowney.

A Laboratory for Practical Instruction is attached to all the Queen's Colleges. The usual Practical Course for the Medical Boards is given in the summer.

### ROYAL COLLEGE OF SCIENCE FOR IRELAND, STEPHEN'S GREEN, DUBLIN.

This College supplies, as far as practicable, a complete course of Instruction in Science, applicable to the Industrial Arts. The Subjects of Instruction are:—Pure and Applied Mathematics, Descriptive Geometry, and Mechanical Drawing, Mechanism, Theoretical and Applied Chemistry, Chemical Analysis, Physics, Botany, Zoology, Geology, and Palæontology, Mineralogy, Mining, Machinery, Surveying, and Agriculture.

*Professor of Theoretical Chemistry.*—W. K. Sullivan, Ph.D., V.P.R.I.

*Professor of Analytical and Applied Chemistry.*—R. Galloway, F.C.S.

*Assistant Chemist.*—W. Plunkett, F.C.S.

A Course of Lectures on Inorganic and Organic Chemistry is delivered by Dr. Sullivan three times a week during the session. Fee for the entire course, £2.

A Course of Lectures on Technological Chemistry is delivered by Mr. Galloway twice a week during the session. Fee for the course, £2.

The Chemical and Metallurgical Laboratories, under the Direction of Mr. Galloway, are open every week day during the session, except Saturday. Instruction is given in the different branches of Analytical Chemistry, including Assaying, and in the methods for performing Chemical research. Each student is taught, not in class, but separately and independently; and he is supplied with a separate working table, with reagents, fuel, water, gas, and the larger and more expensive apparatus. Fee, for the session of nine months, £12; or for three months, £5; or for one month, £2.

There are four Royal Scholarships, of the value of £50 each, yearly, with free Education, including Laboratory Instruction, tenable for two years; two become vacant each year; they are given to students who have been a year in the College. There are also nine Exhibitions attached to the College, of the yearly value of £50 each, with free Education, including Laboratory Instruction, tenable for three years; three become vacant each year. These are awarded at the annual May Examinations of the Science and Art Department.

A Diploma of Associate of the College is granted at the end of the three years' Course.

The Session commences on Monday, October 3rd.



## CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

*Comptes Rendus des Séances de l'Académie des Sciences*, August 29, 1870.

This number contains nothing but a memoir strictly relating to geometry. The meeting of the Academy only lasted for a quarter of an hour.

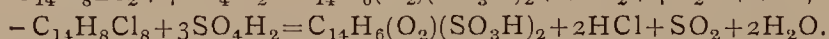
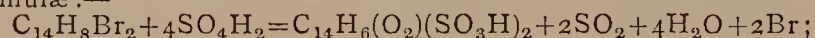
*Berichte der Deutschen Chemischen Gesellschaft zu Berlin*, No. 12, 1870.

This number contains the following original essays and papers:—

**Observations on some of the Compounds of Cerium.**—F. L. Sonnenschein.—After a brief review of the labours of others on this subject, the chief point of interest in this paper is the author's communication of the fact that oxide of cerium is an excellent reagent and test for strychnia. When the last-named substance is well moistened with concentrated sulphuric acid, and there is added to it a mixture of proto-sesquioxide of cerium, a very fine blue colouration ensues, which gradually verges to cherry-red, and then remains unchanged, even for several days. The author states that, by this test, even so small a quantity of strychnia as 0.000001 grm. can be detected. Other alkaloids yield, with the same test, quite different reactions, as, for instance—brucine, orange, becoming at last yellow; morphine, olive-brown, finally brown; narcotine, first brownish, cherry-red, remaining at last cherry-red; quinine, pale yellow; cinchonine remains colourless.

**On Anthrachinon.**—G. Græbe and C. Liebermann.—This memoir treats chiefly on the action of caustic potassa at a high temperature upon anthrachinon, and on the yellow substance, red-coloured in alkaline solution, which is the result of that reaction. The authors state that the yellow colour of the body alluded to is due to the presence of anthrachinhydron, while the anthrahydrochinon is itself a colourless substance.

**Alizarine and Purpurine.**—G. Græbe and C. Liebermann.—They have found that the anthrachinon-bisulpho acid can be obtained directly from anthracen, by the action of a mixture of fuming and ordinary concentrated sulphuric acid upon the bibromide or bichloride of anthracen. This reaction takes place according to the following formulæ:—



The sulpho acids so obtained yield, when fused with caustic potassa, alizarine. The authors describe, further, a series of experiments made with the view to convert alizarine into purpurine, but they did not obtain the last-named substance.

**Wax Contained in Opium.**—O. Hesse.—The author describes, at great length, the process by which, from the so-called *faeces opii*, may be obtained a waxy matter which, on closer investigation, proved to consist of two different substances—viz., cerotate of ceryl and palmitate of ceryl—the latter forming the chief portion of the mass. The first-named substance fuses at 82.5°; the last-named substance,  $\text{C}_{43}\text{H}_{86}\text{O}_2$ , fuses at 79°, is soluble in alcohol, chloroform, ether, and acetone, and crystallises in prismatic-shaped crystals.

**Contribution to our Knowledge on Diamylen.**—W. von Schneider.—This paper is chiefly a series of very lengthy and complicated formulæ.

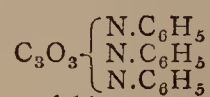
**Bromogallic Acid.**—E. Priwoznik.—This paper is divided into the following sections:—Bromogallic acid and acetyl-chloride; tetracetyl-gallic acid and bromine; gallic acid and bromated bromide of acetyl; bibromogallic acid and oxide of silver; bibromogallic acid and aniline; bibromogallic acid and cyanides.

**New Method of Formation of Chinons.**—P. Weselsky.

**Contribution to our Knowledge on Stanno-Triethyl.**—A. Ladenburg.

**Nitro-Derivatives of the Phenyl-Acetic Acid.**—B. Radziszewski.—The author describes orthonitro-phenyl-acetic acid, a solid substance, soluble in water, fusing at 98°, and crystalline; its salts crystallise with difficulty.

**Carbanilidic Acid Ether.**—H. Schiff.—This memoir is divided into the following sections:—Triphenyl-cyanurate (*cyanurat*); triphenyl-isocyanurate—



diphenyl-carbamide; triphenyl-biuret.

**Aromatic Cyanates.**—A. W. Hofmann.—This lengthy memoir is divided into the following sections:—Phenyl-urethan; phenyl-cyanate;

tolyl-urethan; tolyl-cyanate; xylyl-urethan; xylyl-cyanate; naphthyl-urethan; naphthyl-cyanate.

The following are lecture experiments, communicated by Dr. A. W. Hofmann:—

**Ignition of Hydrogen Compounds in Contact with Fuming Nitric Acid.**—When a few drops of rather warm fuming nitric acid are poured into a glass cylinder containing the non-spontaneous combustible phosphuretted hydrogen gas, a very violent, and even somewhat dangerous detonation ensues. Pure sulphuretted hydrogen, best obtained free from excess of hydrogen, by evolving it from native black sulphuret of antimony and hydrochloric acid gas, becomes immediately ignited when brought into contact with some strong fuming nitric acid. When a few c.c. of moderately-warmed and strong nitric acid are poured into a moderately large-sized cylinder, containing hydriodic acid gas, a red flame bursts forth, violet-coloured fumes are given off, and the interior of the cylinder becomes covered with steel-grey crystals of iodine.

**Colouring Power of Some of the Aniline Dyes.**—After referring to the great many experimental illustrations of the divisibility of matter, the author quotes the following:—The solution of any salt of rosaniline (for this purpose, since only very dilute solutions are used, it is quite indifferent what salt be used), mixed with a few drops of acetic acid, and so diluted with water as to have 1 part of the rosaniline salt to 1,000,000 of water (1 milligram. to 1 litre of liquid) is yet deeply carmine-coloured, and yields a fluid capable of dyeing silk thread, previously moistened with dilute acetic acid. When the coloured liquid is diluted with water, so that 25,000,000 parts of that liquid are present (1-25th of a milligram. of the salt to the litre), the liquid is yet distinctly coloured; and silk, immersed in this bath for a quarter of an hour, is dyed pale red-coloured when removed from the liquid. Even 1 part of the rosaniline salt in 100,000,000 parts of water is visible, if the layer of liquid seen through is about  $\frac{1}{2}$  a metre thick.

**Formation of Nitric Acid during the Combustion of Hydrogen in Air.**—The author describes an experiment, intended to prove, on a large scale, the formation of water during the combustion of hydrogen, so that 30 grms. of water were formed in as many minutes. The water thus formed reddened tincture of litmus, had a decidedly acid taste, and yielded all the characteristic tests of nitric acid.

**Fluid Cyanogen.**—A full translation appeared in our last number.

**Alternate Reduction and Oxidation.**—A well-polished small copper bell is placed in a ring on a triangle, and made red-hot by causing a strong gas flame to play upon it, so as to render the metal red-hot, and, consequently, very soon black. As soon as this is the case, a strong current of hydrogen gas is directed upon the metal, by means of a flexible tube fastened to the neck of a glass funnel large enough to cover the bell. As soon as the hydrogen gas comes into contact with the red-hot metal, the layer of black oxide of copper is removed, and the metal appears as before it was heated. By removing the current of hydrogen, the oxygen of the air again acts upon the hot metal; and thus this alternate oxidation and reduction may be continued, provided the metal had been made thoroughly red-hot to begin with. The hydrogen should be pure, and free from traces, even, of sulphur or arsenic, in order that the experiment be successful.

**Size of the Gas Molecules of Inorganic Compounds.**—R. Rieth.

**Some of the Derivatives of Muconic Acid.**—H. Limpricht.—This paper contains brief notices of the following bodies:—Bromomuconic acid; tribrom-adipinic acid; tetrabrom-adipinic acid; oxy-muconic acid; adipino-tartaric acid; trioxy-adipic acid.

**Preliminary Notice on Alizarine.**—V. Wartha.—The author states that, being engaged with researches on Turkey-red dyeing, he has found that the peculiarly-brilliant red colour known by this term is due to a peculiar combination of alizarine with a fatty acid, which compound is soluble in a mixture of ligroine and ether, and does not even adhere very strongly to the cloth, since it may be readily removed therefrom by the liquid mixture alluded to. On evaporating this solution, there is left a brilliantly scarlet-coloured fatty substance, which, only after having been fused with caustic potassa, exhibits the characteristic reactions of alizarine. The author also states that the preparation of alizarine from madder is readily performed by first exhausting the substance (madder) with ligroine, and next treating it with a mixture of alcohol and hydrochloric acid (alcohol saturated with the gas). On diluting this solution with much water, the alizarine is precipitated, in almost a chemically pure state, in the shape of an orange-coloured flocculent body. A carefully-conducted comparative investigation has proved to the author that the vegetable alizarine sublimates at between 130° and 140°. The synthetically-prepared artificial alizarine requires a temperature of from 280° to 300°. By ligroine, the author means light petroleum oil, such as is used in vapour or sponge lamps.

**Preparation of Naphthylamine.**—M. Ballo.

**Dyes and Pigments to be Derived or Obtained from the Salts of Rosaniline, Brom-Naphthaline, and Naphthylamine.**—M. Ballo.—These memoirs are too lengthy to admit of any useful abstraction.

*Revue des Cours Scientifiques de la France et de l'Etranger*, August 20 and 27, and September 3, 1870.

This number does not contain any original papers relating to chemistry and collateral sciences, but the lectures on the—

**Flying of Birds.**—M. Marey—Are published in full, illustrated by several diagrams and woodcuts.



**Royal School of Mines.**—Director, Sir Roderick Impey Murchison, Bart., K.C.B., F.R.S., &c.  
During the Twentieth Session, 1870-1871, which will commence on the 10th of October, the following COURSES of LECTURES and PRACTICAL DEMONSTRATIONS will be given:—

1. Chemistry—By E. Frankland, Ph.D., F.R.S.
2. Metallurgy—By John Percy, M.D., F.R.S.
3. Natural History—By T. H. Huxley, LL.D., F.R.S.
4. Mineralogy } —By Warrington W. Smyth, M.A., F.R.S.
5. Mining }
6. Geology—By A. C. Ramsay, LL.D., F.R.S.
7. Applied Mechanics—By T. M. Goodeve, M.A.
8. Physics—By Frederick Guthrie, B.A., Ph.D.

Instruction in Mechanical Drawing, by the Rev. J. Haythorne Edgar, M.A.

The Fee for Students desirous of becoming Associates is £30 in one sum, on entrance, or two annual payments of £20, exclusive of the Laboratories.

Pupils are received in the Royal College of Chemistry (the Laboratory of the School), under the direction of Dr. Frankland, and in the Metallurgical Laboratory, under the direction of Dr. Percy.

Tickets to separate Courses of Lectures are issued at £3 and £4 each.

Officers in the Queen's Service, Her Majesty's Consuls, Acting Mining Agents and Managers may obtain tickets at reduced prices.

Certificated Schoolmasters, Pupil-Teachers, and others engaged in education, are also admitted to the Lectures at reduced fees.

His Royal Highness the Prince of Wales grants two Scholarships, and several others have also been established by Government.

For a Prospectus, and information, apply to the Registrar, Royal School of Mines, Jermyn Street, London, S.W.

TRENHAM REEKS, Registrar.

**Pharmaceutical Society of Great Britain,**  
17, Bloomsbury Square, W.C.—School of Pharmacy—Session 1870-71. The Session will commence on Monday, October 3rd, and extend to the end of July.

LECTURES ON CHEMISTRY AND PHARMACY, BY PROFESSOR REDWOOD.

These Lectures will be delivered on Monday, Tuesday, and Wednesday mornings, at 9 o'clock.

- Part 1.—Physics in Relation to Chemistry and Pharmacy.  
„ 2.—Chemistry of Inorganic Bodies.  
„ 3.—Chemistry of Organic Bodies.

ON BOTANY AND MATERIA MEDICA, BY PROFESSOR BENTLEY.

- Part 1.—Structural and Physiological Botany.  
„ 2.—Organic Materia Medica.  
„ 3.—Systematic Botany and Practical Demonstrations of Plants.

The first and second parts of this Course, extending over the Winter months, will be delivered at 17, Bloomsbury Square, on Friday and Saturday mornings, at 9 o'clock. The third part of the Course, on Systematic Botany, will be delivered at the Royal Botanic Gardens, Regent's Park.

FEES.—For Registered Apprentices and Associates of the Society, for either of the above Courses, One Guinea; for either part separately, Half a Guinea. For those not connected with the Society, Two Guineas for either of the above Courses; One Guinea for either part separately.

Students have free admission to the Library and Museum.

LABORATORY.—The Suite of Laboratories for Practical Instruction in General and Pharmaceutical Chemistry will be opened on Monday, October 3rd, under the direction of Professor Atfield. Fee for the entire Session of ten months, Twenty-five Guineas. The Laboratories are open from half-past 9 a.m. till 5 p.m. Students can enter at any period during the Session.

#### PRACTICAL CHEMISTRY.

Laboratory, 60, Gower Street, Bedford Square, W.C.

**Mr. Henry Matthews, F.C.S.,** is prepared to give Instruction in all branches of PRACTICAL CHEMISTRY, particularly in its application to MEDICINE, AGRICULTURE, and COMMERCE.

The Laboratory is open daily, except Saturday, from ten to five o'clock; on Saturday, from ten till one o'clock.

Mr. Matthews is also prepared to undertake ANALYSES of every description.

For Particulars and Prospectuses, apply to Mr. Henry Matthews, the Laboratory, 60, Gower Street, Bedford Square, W.C.

**South London School of Chemistry and Pharmacy,** New Kennington Institute, 289, Kennington Road, S.E.  
Director, and Teacher of Chemistry, Dr. J. Muter, M.A.

Botany and Materia Medica—Dr. Renadin.  
Practical Chemistry—Mr. Earp.

Evening Classes for gentlemen engaged in business in Latin, Mathematics, Chemistry, Botany, Materia Medica, Physics, and Natural History. Special preparation for the Examinations at the London University and Pharmaceutical Society.

For terms and particulars, apply to Dr. Muter, or to Mr. W. Baxter, Secretary.

\*\*\* A Vacancy in the Laboratory for a Pupil-Assistant.

**North London School of Chemistry, Pharmacy, &c.**—For Instruction in Practical Chemistry and Evening Classes for the Study of Chemistry, Botany, Materia Medica, &c. Conducted by Mr. J. C. BRAITHWAITE, for thirteen years Principal Instructor in the Laboratories of the Pharmaceutical Society of Great Britain, and Demonstrator of Practical Pharmacy, Pharmaceutical Latin, &c.

Mr. Braithwaite, having taken the premises adjoining his house, has been enabled nearly to double the size of his Laboratories, and, at the same time, procure a large piece of ground which he has had laid out as a Botanic garden. Every facility is, therefore, offered to Students desirous of acquiring a practical knowledge of this branch of their education.

The Session 1870-1871 will commence on the 3rd of October, when the Laboratories will be re-opened at 10 a.m. for Instruction in Practical Chemistry as applied to Pharmacy, Medicine, Analysis, &c. Pupils can enter at any period. Terms moderate.

THE CHEMICAL and TOXICOLOGICAL CLASS will meet as usual every Monday and Thursday evening, at 8 p.m., commencing October 3rd.

The LATIN CLASS for the reading of Physicians' Prescriptions, Cæsar's Commentaries, &c., every Tuesday and Friday evening, at 8 p.m.

The BOTANICAL and MATERIA MEDICA CLASS, every Wednesday and Saturday evening, at 8 p.m. The usual EXCURSIONS for the STUDY of PRACTICAL BOTANY will be continued every Saturday, until further notice, at 10 a.m.

Fee to either of the above Classes, Half-a-Guinea per Month. Pupils can enter at any period.

Gentlemen Privately Prepared for the Examinations of the Pharmaceutical Society, and the "Modified Examination for Assistants," &c.

All Fees must be paid in advance.

Letters of inquiry should be accompanied with a stamped envelope.

Mr. Braithwaite receives a few Pupils to Board in his house.

Address—54, KENTISH TOWN ROAD, N.W.

**Royal Veterinary College, Great College Street, Camden Town, London.**

The Lectures will commence at the above Institution on Tuesday, October 4th.

The Introductory Address will be delivered by Professor Tuson, at 12 o'clock.

Anatomy, Physiology, and Pathology of the Horse—Professor Spooner.  
Anatomy, Physiology, and Pathology of other Domesticated Animals—Professor Simonds.

Descriptive Anatomy, with Physiology—Deputy Professor Pritchard.  
Chemistry, Materia Medica, and Toxicology—Professor Tuson.  
Anatomical Demonstrations—Assistant Professor Axe.

Infirmity Practice and Clinical Instruction daily—Professors Spooner, Simonds, and Pritchard.

Perpetual fee to all the Lectures, with Infirmity Practice and Anatomical Demonstrations daily, 25 guineas.

It is desirable that intending Pupils should present themselves at the Royal Veterinary College, for matriculation at 10 o'clock a.m. precisely, on Thursday, the 29th of September next.

A Prospectus will be forwarded on application.

CHARLES SPOONER, Principal.

August 25, 1870.

**King's College.—Medical Department.**—The WINTER SESSION will open on Monday, October 3, with an Introductory Lecture by Professor Wood, at 3 p.m.

Warneford Scholarships.—Students entering the Medical Department of this College in October, 1870, will have the exclusive privilege of contending for two Scholarships of £25 each, for three years. These Scholarships are given for proficiency in Divinity, Classics, Mathematics, History, and English.

Five Medical Scholarships are awarded at the close of each Winter Session for proficiency in professional subjects, viz., one of £40 for two years, one of £30 for one year, and three of £20 for one year.

Endowed Prizes of the value of £25, £15, £10, and £4 4s. each, and College Prizes of the value of £50, are annually awarded.

For further information apply personally, or by letter marked outside "Prospectus," to J. W. Cunningham, Esq., Secretary.

**Methylated Spirits.**—David Smith Kidd, Licensed Maker, Commercial Street, Shoreditch, N.E. Also FINISH, FUSEL OIL, and RECT. NAPHTHA.

**Water-glass, or Soluble Silicates of Soda** and Potash, in large or small quantities, and either solid or in solution, at ROBERT RUMNEY'S, Ardwick Chemical Works, Manchester.

**Chloride of Calcium (Purified Muriate of Lime),** total insoluble impurities under  $\frac{1}{4}$  per cent.

CHLORIDE OF BARIUM (Muriate of Baryta), free from Iron and Lead, total impurities, water excepted, under  $\frac{1}{4}$  per cent.

GASKELL, DEACON, & CO.,

ALKALI MANUFACTURERS, WIDNES, LANCASHIRE.



ANALYTICAL LABORATORY AND SCHOOL OF  
TECHNICAL CHEMISTRY.

7, IRWELL CHAMBERS, OLDHALL STREET, LIVERPOOL.

Conducted by A. NORMAN TATE, Analytical and Consulting  
Chemist, and Chemical Engineer.

**E**stablished for Educational Purposes connected with Chemistry in its practical Applications to Manufactures, Commerce, &c.; for the performance of Analyses, Assays, and Chemical Investigations; and for affording information respecting the construction, &c., of Chemical Manufactories, and the conduct of Chemical Manufacturing Processes.

The Course of Instruction, in addition to the ordinary Chemical studies, comprises, as far as possible, all such other subjects as are necessary to give the scientific and practical information required in the Arrangement, Construction, and Management of Chemical Manufactories, and in the Application of Chemistry to Industrial Pursuits.

*Students' Fees may be known on Application.*

Plans, &c., for Chemical Apparatus and Manufactories are supplied, and the Erection of Plant and Buildings is superintended when required.

## College of Chemistry, Duke Street, Liverpool.

(Established 1848.) *Founder and Principal*, Dr. Sheridan Muspratt, M.D., Hon., &c., &c.; *Author of "Chemistry as Applied to the Arts, Manufactures," &c.*, "Dr. Muspratt's Plattner on the Blow-pipe," &c., &c. *Director of Studies, and Analyst*, Martin Murphy F.C.S., &c.

The system adopted is one wholly devoted to a course of Practical Work and Demonstration of the Principles of Chemical Science in its various sections and relations.

The Fee for the Course (twelve months) is Forty Guineas; or, per Session of three months, Twelve Guineas, payable in advance.

The Course and Session may commence at any current date. Students are received for limited periods at special fees. Students provide their own Apparatus, and such reagents of the precious metals as they may want.

Assays and Analyses of every description conducted. Fees moderate.

Chemical Manufacturing Processes and Works investigated, inspected, and supervised.

Full Prospectus on application.

The Certificates of Attendance are acknowledged by the University and Apothecaries' Hall of London, and the Apothecaries' Hall of Ireland, &c.

## TECHNICAL EDUCATION.

## SCIENCE AND ART DEPARTMENT.

Royal College of Science for Ireland,  
Stephen's Green, Dublin.

SESSION 1870-71.

This College supplies, as far as practicable, a complete Course of Instruction in Science applicable to the Industrial Arts, especially those which may be classed broadly under the heads of CHEMICAL MANUFACTURES, MINING, ENGINEERING, and AGRICULTURE.

A Diploma of Associate of the College is granted at the end of the Three Years' Course.

The Course of Instruction is recognised by the Secretary of State for India as Qualifying for Appointments in the Engineering Department.

There are Four Royal Scholarships, of the value of £50 each yearly, with Free Education, including Laboratory Instruction, tenable for two years; two become vacant each year. They are given to Students who have been a year in the College. There are also Nine Exhibitions attached to the College, of the yearly value of £50 each, with Free Education and Laboratory Instruction, tenable for three years; three become vacant each year. These are awarded at the Annual May Examinations of the Science and Art Department.

The Fees are £2 for each Course, or £10 for all the Courses of each year, with the exception of Laboratory, the Fee for which is £12 for the full course of Nine months, or £2 per month.

## SUBJECTS OF INSTRUCTION.

Applied Mathematics, Mechanism and Machinery, Descriptive Geometry, Geometrical, Mechanical, and Engineering Drawing, Experimental Physics, Chemistry (Theoretical and Practical), Botany, Zoology, Geology and Palæontology, Mining, Surveying, Agriculture.

The Laboratory is open for Instruction in Practical Chemistry, Metallurgy, and Assaying, from 10 to 4 o'clock every week day during the Session, except Saturdays and holidays.

The Session commences on Monday, October 3rd.

Programmes may be obtained on application to the Secretary, Royal College of Science, Stephen's Green, Dublin.

FREDERICK J. SIDNEY, LL.D., Secretary.

Manchester Grammar School. Department  
of MATHEMATICS and PHYSICAL SCIENCE.

## PROFESSORS:

Mathematics—T. S. Aldis, M.A.  
Chemistry—W. Marshall Watts, D.Sc.  
Physics—J. Angell.

Arrangements can be made for Students to devote their whole time to Chemistry.

MICHAELMAS TERM commences on Tuesday, September 20th.

## EVENING CLASSES.

Inorganic Chemistry—Lecture Class, Thursday, from 7.30 to 8.30. Fee, 15s.

Practical Chemistry—Monday, from 7 to 9. Fee, £3 3s.

The School is in connection with the Department of Science and Art; and Examinations are held at the School in May. Two hundred and fifty-six pupils passed the last Examination.

## University of Aberdeen.—Chancellor, His

Grace the Duke of Richmond. *Vice-Chancellor and Principal*, the Very Rev. P. C. Campbell, D.D. *Lord Rector*, M. E. Grant Duff, M.A., M.P.

## FACULTY OF MEDICINE—SESSION 1870-71.

WINTER SESSION, commencing on Wednesday, October 26th.

Anatomy—Professor Struthers, M.D. 11 a.m. £3 3s.

Practical Anatomy and Demonstrations—Professor Struthers and the Demonstrator. 9 to 4, and 9 a.m. £2 2s.

Chemistry—Professor Brazier. 3 p.m. £3 3s.

Institutes of Medicine—Professor Ogilvie, M.D. 4 p.m. £3 3s.

Surgery—Professor Pirrie, C.M., F.R.S.E. 10 a.m. £3 3s.

Practice of Medicine—Professor Macrobine, M.D. 3 p.m. £3 3s.

Midwifery and Diseases of Women and Children—Professor Inglis, M.D. 2 p.m. £3 3s.

Zoology, with Comparative Anatomy—Professor Nicol, F.G.S. 2 p.m. £3 3s.

Medical Logic and Medical Jurisprudence—Professor Ogston, M.D. 9 a.m. £3 3s.

SUMMER SESSION, commencing on the First Monday of May.

Botany—Professor Dickie, M.D. 9 a.m. £3 3s.

Materia Medica (100 Lectures)—Professor Harvey, M.D. 3 and 4 p.m. £3 3s.

Practical Anatomy, and Demonstrations—Professor Struthers and the Demonstrator. 9 to 4, and 2 p.m. £2 2s.

Practical Chemistry—Professor Brazier. 10 a.m. £3 3s.

Zoology, with Comparative Anatomy—Professor Nicol. 11 a.m. £3 3s.

The Anatomical Course in Summer includes Instruction in General Anatomy and in the Use of the Microscope; and Instruction in Osteology for Beginners.

Matriculation Fee (including all dues) for the Winter and Summer Sessions, £1. For the Summer Session alone, 10s.

Royal Infirmary: Daily at Noon. Physicians—Drs. Harvey, Smith, and Beveridge. Surgeons—Drs. Pirrie, Kerr, and Fiddes. Junior Surgeon—Dr. A. Ogston. Ophthalmic Surgeon—(Vacant). Dental Surgeon—Mr. Williamson. Pathologist—Dr. Rodger. Perpetual Fee to Hospital Practice, £6—or, first year, £3 10s.; second year, £3.

Clinical Medicine—Drs. Harvey and Smith. £3 3s.

Clinical Surgery—Drs. Pirrie, Kerr, and Fiddes. £3 3s.

Pathological Anatomy—Dr. Rodger. £2 2s.

A three month's course of Practical Ophthalmology is given in Summer by Dr. A. Ogston, commencing early in May.

General Dispensary and Lying-in and Vaccine Institution: Daily. Eye Institution—Daily.

Practical Midwifery—Under the Superintendence of Dr. Inglis.

Royal Lunatic Asylum: Physician—Dr. Jameson. Clinical Instruction is given for three months in the year.

The Regulations relative to the Registration of Students of Medicine, and the Granting of Degrees in Medicine and Surgery, may be had of Dr. Macrobine, Dean of the Faculty of Medicine.

Full information regarding the Classes and Degrees in the Faculties of Arts, Law, and Divinity, and in regard to Bursaries and Scholarships, will be found in the UNIVERSITY CALENDAR, published by Messrs. Wyllie and Son, Union Street, Aberdeen—by post, 2s. 2d.

## Lectures on Mineralogy applied to Geology

and the Arts are given by Professor TENNANT, F.G.S., at King's College, London, on Wednesday and Friday Mornings, from 9 to 10 o'clock, and on Thursday Evenings from 8 to 9, from October 7th, to Christmas, to which the public are admitted on paying the College Fees, namely, Two Guineas to the Morning Course, and One Guinea to the Evening.

The Students are accompanied by the Professor to the Museum of Practical Geology, the British Museum, and other Public institutions, and also on excursions into the country.

MR. TENNANT also gives private instruction in Mineralogy and Geology at his residence, 149, Strand, London, W.C.



# THE CHEMICAL NEWS.

VOL. XXII. No. 564.

## BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

LIVERPOOL MEETING, SEPTEMBER 14, 1870.

### INAUGURAL ADDRESS OF THE PRESIDENT,

THOMAS H. HUXLEY, LL.D., F.R.S., &c.,

Professor of Natural History in the Royal School of Mines.

MY LORDS, LADIES, AND GENTLEMEN,—

It has long been the custom for the newly-installed President of the British Association for the Advancement of Science to take advantage of the elevation of the position in which the suffrages of his colleagues had, for the time, placed him, and, casting his eyes around the horizon of the scientific world, to report to them what could be seen from his watch-tower; in what directions the multitudinous divisions of the noble army of the improvers of natural knowledge were marching; what important strongholds of the great enemy of us all, Ignorance, had been recently captured; and, also, with due impartiality, to mark where the advanced posts of science had been driven in, or a long-continued siege had made no progress.

I propose to endeavour to follow this ancient precedent, in a manner suited to the limitations of my knowledge and of my capacity. I shall not presume to attempt a panoramic survey of the world of Science, nor even to give a sketch of what is doing in the one great province of Biology, with some portions of which my ordinary occupations render me familiar. But I shall endeavour to put before you the history of the rise and progress of a single biological doctrine; and I shall try to give some notion of the fruits, both intellectual and practical, which we owe, directly or indirectly, to the working out, by seven generations of patient and laborious investigators, of the thought which arose, more than two centuries ago, in the mind of a sagacious and observant Italian naturalist.

It is a matter of every day experience that it is difficult to prevent many articles of food from becoming covered with mould; that fruit, sound enough to all appearance, often contains grubs at the core; that meat, left to itself in the air, is apt to putrefy and swarm with maggots. Even ordinary water, if allowed to stand in an open vessel, sooner or later becomes turbid and full of living matter.

The philosophers of antiquity, interrogated as to the cause of this phenomena, were provided with a ready and a plausible answer. It did not enter their minds even to doubt that these low forms of life were generated in the matters in which they made their appearance. Lucretius, who had drunk deeper of the scientific spirit than any poet of ancient or modern times except Goethe, intends to speak as a philosopher, rather than as a poet, when he writes that "with good reason the earth has gotten the name of mother, since all things are produced out of the earth. And many living creatures, even now, spring out of the earth, taking form by the rains and the heat of the sun." The axiom of ancient science, "that the corruption of one thing is the birth of another," had its popular embodiment in the notion that a seed dies before the young plant springs from it; a belief so widespread and

so fixed, that Saint Paul appeals to it in one of the most splendid outbursts of his fervid eloquence—

"Thou fool, that which thou sowest is not quickened, except it die."

The proposition that life may, and does, proceed from that which has no life, then, was held alike by the philosophers, the poets, and the people, of the most enlightened nations, eighteen hundred years ago; and it remained the accepted doctrine of learned and unlearned Europe, through the Middle Ages, down even to the seventeenth century.

It is commonly counted among the many merits of our great countryman, Harvey, that he was the first to declare the opposition of fact to venerable authority in this, as in other matters; but I can discover no justification for this widespread notion. After careful search through the "Exercitationes de Generatione," the most that appears clear to me is, that Harvey believed all animals and plants to spring from what he terms a "*primordium vegetale*," a phrase which may nowadays be rendered "a vegetative germ;" and this, he says, is "*oviforme*," or "egg-like;" not, he is careful to add, that it necessarily has the shape of an egg, but because it has the constitution and nature of one. That this "*primordium oviforme*" must needs, in all cases, proceed from a living parent is nowhere expressly maintained by Harvey, though such an opinion may be thought to be implied in one or two passages; while, on the other hand, he does, more than once, use language which is consistent only with a full belief in spontaneous or equivocal generation. In fact, the main concern of Harvey's wonderful little treatise is not with generation, in the physiological sense, at all, but with development; and his great object is the establishment of the doctrine of epigenesis.

The first distinct enunciation of the hypothesis that all living matter has sprung from pre-existing living matter, came from a contemporary, though a junior, of Harvey, a native of that country, fertile in men great in all departments of human activity, which was to intellectual Europe, in the sixteenth and seventeenth centuries, what Germany is in the nineteenth. It was in Italy, and from Italian teachers, that Harvey received the most important part of his scientific education. And it was a student trained in the same schools, Francesco Redi—a man of the widest knowledge and most versatile abilities, distinguished alike as scholar, poet, physician, and naturalist—who, just two hundred and two years ago, published his "*Esperienze intorno alla Generazione degli Insetti*," and gave to the world the idea, the growth of which it is my purpose to trace. Redi's book went through five editions in twenty years; and the extreme simplicity of his experiments, and the clearness of his arguments, gained for his views, and for their consequences, almost universal acceptance.

Redi did not trouble himself much with speculative considerations, but attacked particular cases of what was supposed to be "spontaneous generation" experimentally. Here are dead animals, or pieces of meat, says he; I expose them to the air in hot weather, and in a few days they swarm with maggots. You tell me that these are generated in the dead flesh; but, if I put similar bodies, while quite fresh, into a jar, and tie some fine gauze over the top of the jar, not a maggot makes its appearance, while the dead substances, nevertheless, putrefy just in the same way as before. It is obvious, therefore, that the maggots are not generated by the corruption of the meat; and that the cause of their formation must be a something which is kept away by gauze. But gauze will not keep away æriform bodies, or fluids. This something must, therefore, exist in the form of solid particles too big to get through the gauze. Nor is one long left in doubt what these solid particles are; for the blowflies, attracted by the odour of the meat, swarm round the vessel, and, urged by a powerful, but, in this case, misleading instinct, lay eggs, out of which maggots are immediately hatched, upon the gauze. The conclusion, therefore, is unavoidable; the maggots are not generated by the meat, but the eggs



which give rise to them are brought through the air by the flies.

These experiments seem almost childishly simple, and one wonders how it was that no one ever thought of them before. Simple as they are, however, they are worthy of the most careful study, for every piece of experimental work since done, in regard to this subject, has been shaped upon the model furnished by the Italian philosopher. As the results of his experiments were the same, however varied the nature of the materials he used, it is not wonderful that there arose in Redi's mind a presumption that, in all such cases of the seeming production of life from dead matter, the real explanation was the introduction of living germs from without into that dead matter. And thus the hypothesis that living matter always arises by the agency of pre-existing living matter, took definite shape; and had, henceforward, a right to be considered and a claim to be refuted, in each particular case, before the production of living matter in any other way could be admitted by careful reasoners. It will be necessary for me to refer to this hypothesis so frequently, that, to save circumlocution, I shall call it the hypothesis of *Biogenesis*; and I shall term the contrary doctrine—that living matter may be produced by not living matter—the hypothesis of *Abiogenesis*.

In the seventeenth century, as I have said, the latter was the dominant view, sanctioned alike by antiquity and by authority; and it is interesting to observe that Redi did not escape the customary tax upon a discoverer of having to defend himself against the charge of impugning the authority of the Scriptures; for his adversaries declared that the generation of bees from the carcass of a dead lion is affirmed, in the book of Judges, to have been the origin of the famous riddle with which Samson perplexed the Philistines—

"Out of the eater came forth meat,  
And out of the strong came forth sweetness."

Against all odds, however, Redi, strong with the strength of demonstrable fact, did splendid battle for Biogenesis; but it is remarkable that he held the doctrine in a sense which, if he had lived in these times, would have infallibly caused him to be classed among the defenders of "spontaneous generation." "Omne vivum ex vivo," "no life without antecedent life," aphoristically sums up Redi's doctrine; but he went no further. It is most remarkable evidence of the philosophic caution and impartiality of his mind, that, although he had speculatively anticipated the manner in which grubs really are deposited in fruits and in the galls of plants, he deliberately admits that the evidence is insufficient to bear him out; and he therefore prefers the supposition that they are generated by a modification of the living substance of the plants themselves. Indeed, he regards these vegetable growths as organs, by means of which the plant gives rise to an animal, and looks upon this production of specific animals as the final cause of the galls, and of, at any rate some, fruits. And he proposes to explain the occurrence of parasites within the animal body in the same way.

It is of great importance to apprehend Redi's position rightly; for the lines of thought he laid down for us are those upon which naturalists have been working ever since. Clearly, he held *Biogenesis* as against *Abiogenesis*; and I shall immediately proceed, in the first place, to enquire how far subsequent investigation has borne him out in so doing.

But Redi also thought that there were two modes of Biogenesis. By the one method, which is that of common and ordinary occurrence, the living parent gives rise to offspring which passes through the same cycle of changes as itself—like gives rise to like; and this has been termed *Homogenesis*. By the other mode, the living parent was supposed to give rise to offspring which passed through a totally different series of states from those exhibited by the parent, and did not return into the cycle of the parent; this is what ought to be called *Heterogenesis*, the offspring being altogether, and permanently, unlike the parent.

The term *Heterogenesis*, however, has unfortunately been used in a different sense, and M. Milne-Edwards has, therefore, substituted for it *Xenogenesis*, which means the generation of something foreign. After discussing Redi's hypothesis of universal Biogenesis, then, I shall go on to ask how far the growth of science justifies his other hypothesis of *Xenogenesis*.

The progress of the hypothesis of Biogenesis was triumphant and unchecked for nearly a century. The application of the microscope to anatomy in the hands of Grew, Leeuwenhoek, Swammerdam, Lyonet, Vallisnieri, Reaumur, and other illustrious investigators of nature of that day, displayed such a complexity of organisation in the lowest and minutest forms, and everywhere revealed such a prodigality of provision for their multiplication by germs of one sort or another, that the hypothesis of Abiogenesis began to appear not only untrue, but absurd; and, in the middle of the eighteenth century, when Needham and Buffon took up the question, it was almost universally discredited.

But the skill of the microscope-makers of the eighteenth century soon reached its limit. A microscope magnifying 400 diameters was a *chef-d'œuvre* of the opticians of that day; and, at the same time, by no means trustworthy. But a magnifying power of 400 diameters, even when definition reaches the exquisite perfection of our modern achromatic lenses, hardly suffices for the mere discernment of the smallest forms of life. A speck, only 1-25th of an inch in diameter, has, at 10 inches from the eye, the same apparent size as an object 1-10,000th of an inch in diameter, when magnified 400 times; but forms of living matter abound the diameter of which is not more than 1-40,000th of an inch. A filtered infusion of hay, allowed to stand for two days, will swarm with living things, among which, any which reaches the diameter of a human red blood-corpuscle, or about 1-3200th of an inch, is a giant. It is only by bearing these facts in mind, that we can deal fairly with the remarkable statements and speculations put forward by Buffon and Needham in the middle of the eighteenth century.

When a portion of any animal or vegetable body is infused in water, it gradually softens and disintegrates; and, as it does so, the water is found to swarm with minute active creatures, the so-called Infusorial Animalcules, none of which can be seen, except by the aid of the microscope; while a large proportion belong to the category of smallest things of which I have spoken, and which must have all looked like mere dots and lines under the ordinary microscopes of the eighteenth century.

Led by various theoretical considerations which I cannot now discuss, but which looked promising enough in the lights of that day, Buffon and Needham doubted the applicability of Redi's hypothesis to the infusorial animalcules, and Needham very properly endeavoured to put the question to an experimental test. He said to himself, if these infusorial animalcules come from germs, their germs must exist either in the substance infused, or in the water with which the infusion is made, or in the superjacent air. Now the vitality of all germs is destroyed by heat. Therefore, if I boil the infusion, cork it up carefully, cementing the cork over with mastic, and then heat the whole vessel by heaping hot ashes over it, I must needs kill whatever germs are present. Consequently, if Redi's hypothesis hold good, when the infusion is taken away, and allowed to cool, no animalcules ought to be developed in it; whereas, if the animalcules are not dependent on pre-existing germs, but are generated from the infused substance, they ought, by and by, to make their appearance. Needham found that, under the circumstances in which he made his experiments, animalcules always did arise in the infusions, when a sufficient time had elapsed to allow for their development.

In much of his work Needham was associated with Buffon, and the results of their experiments fitted in admirably with the great French naturalist's hypothesis of "organic molecules," according to which, life is the inde-



feasible property of certain indestructible molecules of matter, which exist in all living things, and have inherent activities by which they are distinguished from not living matter. Each individual living organism is formed by their temporary combination. They stand to it in the relation of the particles of water to a cascade, or a whirlpool; or to a mould, into which the water is poured. The form of the organism is thus determined by the reaction between external conditions and the inherent activities of the organic molecules of which it is composed; and, as the stoppage of a whirlpool destroys nothing but a form, and leaves the molecules of the water, with all their inherent activities intact, so, what we call the death and putrefaction of an animal, or of a plant, is merely the breaking up of the form, or manner of association, of its constituent organic molecules, which are then set free as infusorial animalcules.

It will be perceived that this doctrine is by no means identical with *Abiogenesis*, with which it is often confounded. On this hypothesis, a piece of beef, or a handful of hay, is dead only in a limited sense. The beef is dead ox, and the hay is dead grass; but the "organic molecules" of the beef or the hay are not dead, but are ready to manifest their vitality as soon as the bovine or herbaceous shrouds in which they are imprisoned are rent by the macerating action of water. The hypothesis, therefore, must be classified under *Xenogenesis*, rather than under *Abiogenesis*. Such as it was, I think it will appear, to those who will be just enough to remember that it was propounded before the birth of modern chemistry and of the modern optical arts, to be a most ingenious and suggestive speculation.

But the great tragedy of Science—the slaying of a beautiful hypothesis by an ugly fact—which is so constantly being enacted under the eyes of philosophers, was played, almost immediately, for the benefit of Buffon and Needham.

Once more, an Italian, the Abbé Spallanzani, a worthy successor and representative of Redi in his acuteness, his ingenuity, and his learning, subjected the experiments and the conclusions of Needham to a searching criticism. It might be true that Needham's experiments yielded results such as he had described, but did they bear out his arguments? Was it not possible, in the first place, that he had not completely excluded the air by his corks and mastic? And was it not possible, in the second place, that he had not sufficiently heated his infusions and the superjacent air? Spallanzani joined issue with the English naturalist on both these pleas; and he showed that if, in the first place, the glass vessels in which the infusions were contained were hermetically sealed, by fusing their necks; and if, in the second place, they were exposed to the temperature of boiling-water for three-quarters of an hour, no animalcules ever made their appearance within them. It must be admitted that the experiments and arguments of Spallanzani furnish a complete and a crushing reply to those of Needham. But we all too often forget that it is one thing to refute a proposition and another to prove the truth of a doctrine which implicitly, or explicitly, contradicts that proposition; and the advance of science soon showed that, though Needham might be quite wrong, it did not follow that Spallanzani was quite right.

Modern Chemistry, the birth of the latter half of the eighteenth century, grew apace, and soon found herself face to face with the great problems which Biology had vainly tried to attack without her help. The discovery of oxygen led to the laying of the foundations of a scientific theory of respiration, and to an examination of the marvellous interactions of organic substances with oxygen. The presence of free oxygen appeared to be one of the conditions of the existence of life, and of those singular changes in organic matters which are known as fermentation and putrefaction. The question of the generation of the infusory animalcules thus passed into a new phase. For what might not have happened to the organic matter of the infusions, or to the oxygen of the air, in Spallanzani's experiments?

What security was there that the development of life which ought to have taken place had not been checked, or prevented, by these changes?

The battle had to be fought again. It was needful to repeat the experiments under conditions which would make sure that neither the oxygen of the air, nor the composition of the organic matter, was altered, in such a manner as to interfere with the existence of life.

Schulze and Schwann took up the question from this point of view in 1836 and 1837. The passage of air through red-hot glass tubes, or through strong sulphuric acid, does not alter the proportion of its oxygen, while it must needs arrest, or destroy, any organic matter which may be contained in the air. These experimenters, therefore, contrived arrangements by which the only air which should come into contact with a boiled infusion should be such as had either passed through red-hot tubes or through strong sulphuric acid. The result which they obtained was, that an infusion so treated developed no living things, while, if the same infusion was afterwards exposed to the air, such things appeared rapidly and abundantly. The accuracy of these experiments has been alternately denied and affirmed. Supposing them to be accepted, however, all that they really proved was, that the treatment to which the air was subjected destroyed *something* that was essential to the development of life in the infusion. This "something" might be gaseous, fluid, or solid; that it consisted of germs remained only an hypothesis of greater or less probability.

Contemporaneously with these investigations, a remarkable discovery was made by Cagniard de la Tour. He found that common yeast is composed of a vast accumulation of minute plants. The fermentation of must, or of wort, in the fabrication of wine and of beer is always accompanied by the rapid growth and multiplication of these *Torulæ*. Thus, fermentation, in so far as it was accompanied by the development of microscopical organisms in enormous numbers, became assimilated to the decomposition of an infusion of ordinary animal or vegetable matter; and it was an obvious suggestion that the organisms were, in some way or other, the causes both of fermentation and of putrefaction. The chemists, with Berzelius and Liebig at their head, at first laughed this idea to scorn; but, in 1843, a man, then very young, who has since performed the unexampled feat of attaining to high eminence, alike in Mathematics, Physics, and Physiology—I speak of the illustrious Helmholtz—reduced the matter to the test of experiment by a method alike elegant and conclusive. Helmholtz separated a putrefying, or a fermenting, liquid, from one which was simply putrescible, or fermentable, by a membrane, which allowed the fluids to pass through and become intermixed, but stopped the passage of solids. The result was that, while the putrescible, or the fermentable, liquids became impregnated with the results of the putrescence, or fermentation, which was going on on the other side of the membrane, they neither putrefied (in the ordinary way) nor fermented; nor were any of the organisms which abounded in the fermenting, or putrefying, liquid generated in them. Therefore, the cause of the development of these organisms must lie in something which cannot pass through membrane; and as Helmholtz's investigations were long antecedent to Graham's researches upon colloids, his natural conclusion was that the agent thus intercepted must be a solid material. In point of fact, Helmholtz's experiments narrowed the issue to this: that which excites fermentation and putrefaction, and at the same time gives rise to living forms in a fermentable, or putrescible, fluid, is not a gas and is not a diffusible fluid; therefore, it is either a colloid, or it is matter divided into very minute solid particles.

The researches of Schroeder and Dusch, in 1854, and of Schroeder alone, in 1859, cleared up this point by experiments which are simply refinements upon those of Redi. A lump of cotton-wool is, physically speaking, a pile of many thicknesses of a very fine gauze, the fineness of the



meshes of which depends upon the closeness of the compression of the wool. Now, Schroeder and Dusch found, that, in the case of all the putrefiable materials which they used (except milk and yolk of egg), an infusion boiled, and then allowed to come into contact with no air but such as had been filtered through cotton-wool, neither putrefied nor fermented, nor developed living forms. It is hard to imagine what the fine sieve formed by the cotton-wool could have stopped except minute solid particles. Still the evidence was incomplete until it had been positively shown, first, that ordinary air does contain such particles; and, secondly, that filtration through cotton-wool arrests these particles and allows only physically pure air to pass. This demonstration has been furnished within the last year by the remarkable experiments of Professor Tyndall. It has been a common objection of Abiogenists that, if the doctrine of Biogeny is true, the air must be thick with germs; and they regard this as the height of absurdity. But Nature occasionally is exceedingly unreasonable, and Professor Tyndall has proved that this particular absurdity may, nevertheless, be a reality. He has demonstrated that ordinary air is no better than a sort of stirabout of excessively minute solid particles; that these particles are almost wholly destructible by heat; and that they are strained off, and the air rendered optically pure, by being passed through cotton-wool.

But it remains yet in the order of logic, though not of history, to show that, among these solid destructible particles, there really do exist germs capable of giving rise to the development of living forms in suitable menstrua. This piece of work was done by M. Pasteur in those beautiful researches which will ever render his name famous; and which, in spite of all attacks upon them, appear to me now, as they did seven years ago,\* to be models of accurate experimentation and logical reasoning. He strained air through cotton-wool, and found, as Schroeder and Dusch had done, that it contained nothing competent to give rise to the development of life in fluids highly fitted for that purpose. But the important further links in the chain of evidence added by Pasteur are three. In the first place, he subjected to microscopic examination the cotton-wool which had served as strainer, and found that sundry bodies, clearly recognisable as germs, were among the solid particles strained off. Secondly, he proved that these germs were competent to give rise to living forms by simply sowing them in a solution fitted for their development. And, thirdly, he showed, that the incapacity of air strained through cotton-wool to give rise to life, was not due to any occult change effected in constituents of the air by the wool, by proving that the cotton-wool might be dispensed with altogether, and perfectly free access left between the exterior air and that in the experimental flask. If the neck of the flask is drawn out into a tube and bent downwards; and if, after the contained fluid has been carefully boiled, the tube is heated sufficiently to destroy any germs which may be present in the air which enters as the fluid cools, the apparatus may be left to itself for any time, and no life will appear in the fluid. The reason is plain. Although there is free communication between the atmosphere laden with germs and the germless air in the flask, contact between the two takes place only in the tube; and as the germs cannot fall upwards, and there are no currents, they never reach the interior of the flask. But if the tube be broken short off where it proceeds from the flask, and free access be thus given to germs falling vertically out of the air, the fluid which has remained clear and desert for months, becomes, in a few days, turbid and full of life.

These experiments have been repeated over and over again by independent observers with entire success; and there is one very simple mode of seeing the facts for oneself, which I may as well describe.

Prepare a solution (much used by M. Pasteur, and

often called "Pasteur's solution") composed of water with tartrate of ammonia, sugar, and yeast-ash dissolved therein.\* Divide it into three portions in as many flasks; boil all three for a quarter of an hour; and, while the steam is passing out, stop the neck of one with a large plug of cotton-wool, so that this also may be thoroughly steamed. Now set the flasks aside to cool, and when their contents are cold, added to one of the open ones a drop of filtered infusion of hay which has stood for twenty-four hours, and is, consequently, full of the active and excessively minute organisms known as *Bacteria*. In a couple of days of ordinary warm weather, the contents of this flask will be milky, from the enormous multiplication of *Bacteria*. The other flask, open and exposed to the air, will, sooner or later, become milky with *Bacteria*, and patches of mould may appear in it; while the liquid in the flask, the neck of which is plugged with cotton-wool, will remain clear for an indefinite time. I have sought in vain for an explanation of these facts, except the obvious one, that the air contains germs competent to give rise to *Bacteria*, such as those with which the first solution has been knowingly and purposely inoculated, and to the mould *fungi*. And I have not yet been able to meet with any advocate of Abiogenesis who seriously maintains that the atoms of sugar, tartrate of ammonia, yeast-ash, and water, under no influence but that of free access of air and the ordinary temperature, re-arrange themselves and give rise to the protoplasm of *Bacterium*. But the alternative is to admit that these *Bacteria* arise from germs in the air; and if they are thus propagated, the burden of proof, that other like forms are generated in a different manner, must rest with the assertor of that proposition.

To sum up the effect of this long chain of evidence:—

It is demonstrable, that a fluid eminently fit for the development of the lowest forms of life, but which contains neither germs nor any protein compound, gives rise to living things in great abundance, if it is exposed to ordinary air; while no such development takes place if the air with which it is in contact is mechanically freed from the solid particles, which ordinarily float in it and which may be made visible by appropriate means.

It is demonstrable, that the great majority of these particles are destructible by heat, and that some of them are germs, or living particles, capable of giving rise to the same forms of life as those which appear when the fluid is exposed to unpurified air.

It is demonstrable, that inoculation of the experimental fluid with a drop of liquid known to contain living particles, gives rise to the same phenomena as exposure to unpurified air.

And it is further certain that these living particles are so minute that the assumption of their suspension in ordinary air presents not the slightest difficulty. On the contrary, considering their lightness and the wide diffusion of the organisms which produce them, it is impossible to conceive that they should not be suspended in the atmosphere in myriads.

Thus, the evidence, direct and indirect, in favour of *Biogenesis* for all known forms of life must, I think, be admitted to be of great weight.

On the other side, the sole assertions worthy of attention are, that hermetically sealed fluids, which have been exposed to great and long-continued heat, have sometimes exhibited living forms of low organisation when they have been opened.

The first reply that suggests itself is the probability that there must be some error about these experiments, because they are performed on an enormous scale every day, with quite contrary results. Meat, fruits, vegetables, the very materials of the most fermentable and putrescible infusions are preserved to the extent, I suppose I may say, of thousands of tons every year, by a method which

\* Lectures to Working Men on the Causes of the Phenomena of Organic Nature," 1863.

\* Infusion of hay, treated in the same way, yields similar results but as it contains organic matter, the argument which follows cannot be based upon it.



is a mere application of Spallanzani's experiment. The matters to be preserved are well boiled in a tin case provided with a small hole, and this hole is soldered up when all the air in the case has been replaced by steam. By this method they may be kept for years, without putrefying, fermenting, or getting mouldy. Now this is not because oxygen is excluded, inasmuch as it is now proved that free oxygen is not necessary for either fermentation or putrefaction. It is not because the tins are exhausted of air, for *Vibriones* and *Bacteria* live, as Pasteur has shown, without air or free oxygen. It is not because the boiled meats or vegetables are not putrescible or fermentable, as those who have had the misfortune to be in a ship supplied with unskilfully closed tins well know. What is it, therefore, but the exclusion of germs? I think that Abiogenists are bound to answer this question before they ask us to consider new experiments of precisely the same order.

And in the next place, if the results of the experiments I refer to are really trustworthy, it by no means follows that abiogenesis has taken place. The resistance of living matter to heat is known to vary within considerable limits, and to depend, to some extent, upon the chemical and physical qualities of the surrounding medium. But if, in the present state of science, the alternative is offered us, either germs can stand a greater heat than has been supposed, or the molecules of dead matter, for no valid or intelligible reason that is assigned, are able to re-arrange themselves into living bodies, exactly such as can be demonstrated to be frequently produced in another way, I cannot understand how choice can be, even for a moment, doubtful.

But though I cannot express this conviction of mine too strongly, I must carefully guard myself against the supposition that I intend to suggest that no such thing as abiogenesis ever has taken place in the past, or ever will take place in the future. With organic chemistry, molecular physics, and physiology yet in their infancy, and every day making prodigious strides, I think it would be the height of presumption for any man to say that the conditions under which matter assumes the properties we call "vital" may not, some day, be artificially brought together. All I feel justified in affirming is, that I see no reason for believing that the feat has been performed yet.

And, looking back through the prodigious vista of the past, I find no record of the commencement of life, and, therefore, I am devoid of any means of forming a definite conclusion as to the conditions of its appearance. Belief, in the scientific sense of the word, is a serious matter, and needs strong foundations. To say, therefore, in the admitted absence of evidence, that I have any belief as to the mode in which the existing forms of life have originated, would be using words in a wrong sense. But expectation is permissible where belief is not; and if it were given me to look beyond the abyss of geologically recorded time to the still more remote period when the earth was passing through physical and chemical conditions, which it can no more see again than a man can recall his infancy, I should expect to be a witness of the evolution of living protoplasm from not living matter. I should expect to see it appear under forms of great simplicity, endowed, like existing Fungi, with the power of determining the formation of new protoplasm from such matters as ammonium carbonates, oxalates and tartrates, alkaline and earthy phosphates, and water, without the aid of light. That is the expectation to which analogical reasoning leads me; but I beg you once more to recollect that I have no right to call my opinion anything but an act of philosophical faith.

So much for the history of the progress of Redi's great doctrine of Biogenesis, which appears to me, with the limitations I have expressed, to be victorious along the whole line at the present day.

As regards the second problem offered to us by Redi, whether Xenogenesis obtains, side by side with Homogenesis; whether, that is, there exist not only the ordinary living things, giving rise to offspring which run through

the same cycle as themselves, but also others, producing offspring which are of a totally different character from themselves, the researches of two centuries have led to a different result. That the grubs found in galls are no product of the plants on which the galls grow, but are the result of the introduction of the eggs of insects into the substance of these plants, was made out by Vallisnieri, Reaumur, and others, before the end of the first half of the eighteenth century. The tapeworms, bladderworms, and flukes continued to be a stronghold of the advocates of Xenogenesis for a much longer period. Indeed, it is only within the last thirty years that the splendid patience of Von Siebold, Van Beneden, Leuckart, Küchenmeister, and other helminthologists, has succeeded in tracing every such parasite, often through the strangest wanderings and metamorphoses, to an egg derived from a parent, actually or potentially like itself; and the tendency of inquiries elsewhere has all been in the same direction. A plant may throw off bulbs, but these, sooner or later, give rise to seeds or spores, which develop into the original form.

A polype may give rise to Medusæ, or a pluteus to an Echinoderm, but the Medusa and the Echinoderm give rise to eggs which produce polypes or plutei, and they are therefore only stages in the cycle of life of the species.

But if we turn to pathology it offers us some remarkable approximations to true Xenogenesis.

As I have already mentioned, it has been known since the time of Vallisnieri and of Reaumur, that galls in plants, and tumours in cattle, are caused by insects, which lay their eggs in those parts of the animal or vegetable frame of which these morbid structures are outgrowths. Again, it is a matter of familiar experience to everybody that mere pressure on the skin will give rise to a corn. Now the gall, the tumour, and the corn are parts of the living body, which have become, to a certain degree, independent and distinct organisms. Under the influence of certain external conditions, elements of the body, which should have developed in due subordination to its general plan, set up for themselves and apply the nourishment which they receive to their own purposes.

From such innocent productions as corns and warts, there are all gradations to the serious tumours which, by their mere size and the mechanical obstruction they cause, destroy the organism out of which they are developed; while, finally, in those terrible structures known as cancers, the abnormal growth has acquired powers of reproduction and multiplication, and is only morphologically distinguishable from the parasitic worm, the life of which is neither more nor less closely bound up with that of the infested organism.

If there were a kind of diseased structure, the histological elements of which were capable of maintaining a separate and independent existence out of the body, it seems to me that the shadowy boundary between morbid growth and Xenogenesis would be effaced. And I am inclined to think that the progress of discovery has almost brought us to this point already. I have been favoured by Mr. Simon with an early copy of the last published of the valuable "Reports on the Public Health," which, in his capacity of their Medical Officer, he annually presents to the Lords of the Privy Council. The Appendix to this Report contains an introductory essay "On the Intimate Pathology of Contagion," by Dr. Burdon Sanderson, which is one of the clearest, most comprehensive, and well-reasoned discussions of a great question which has come under my notice for a long time. I refer you to it for details and for the authorities for the statements I am about to make.

You are familiar with what happens in vaccination. A minute cut is made in the skin, and an infinitesimal quantity of vaccine matter is inserted into the wound. Within a certain time, a vesicle appears in the place of the wound, and the fluid which distends this vesicle is vaccine matter, in quantity a hundred- or a thousandfold that which was originally inserted. Now what has taken place in the course of this operation? Has the vaccine



matter by its irritative property produced a mere blister, the fluid of which has the same irritative property? Or does the vaccine matter contain living particles, which have grown and multiplied where they have been planted? The observations of M. Chauveau, extended and confirmed by Dr. Sanderson himself, appear to leave no doubt upon this head. Experiments, similar in principle to those of Helmholtz on fermentation and putrefaction, have proved that the active element in the vaccine lymph is non-diffusible, and consists of minute particles exceeding 1-20,000th of an inch in diameter, which are made visible in the lymph by the microscope. Similar experiments have proved that two of the most destructive of epizootic diseases, sheep-pox and glanders, are also dependent for their existence and their propagation upon extremely small living solid particles, to which the title of *microzymes* is applied. An animal suffering under either of these terrible diseases is a source of infection and contagion to others, for precisely the same reason as a tub of fermenting beer is capable of propagating its fermentation by "infection," or "contagion," to fresh wort. In both cases it is the solid living particles which are efficient; the liquid in which they float, and at the expense of which they live, being altogether passive.

Now arises the question are these microzymes the results of *Homogenesis* or of *Xenogenesis*; are they capable, like the *Torulæ* of yeast, of arising only by the development of pre-existing germs; or may they be, like the constituents of a nut-gall, the results of a modification and individualisation of the tissues of the body in which they are found, resulting from the operation of certain conditions? Are they parasites in the zoological sense, or are they merely what Virchow has called "heterologous growths?" It is obvious that this question has the most profound importance, whether we look at it from a practical or from a theoretical point of view. A parasite may be stamped out by destroying its germs, but a pathological product can only be annihilated by removing the conditions which give rise to it.

It appears to me that this great problem will have to be solved for each zymotic disease separately, for analogy cuts two ways. I have dwelt upon the analogy of pathological modification, which is in favour of the xenogenetic origin of microzymes; but I must now speak of the equally strong analogies in favour of the origin of such pestiferous particles by the ordinary process of the generation of like from like.

It is, at present, a well-established fact that certain diseases, both of plants and of animals, which have all the characters of contagious and infectious epidemics, are caused by minute organisms. The smut of wheat is a well-known instance of such a disease, and it cannot be doubted that the grape-disease and the potato-disease fall under the same category. Among animals, insects are wonderfully liable to the ravages of contagious and infectious diseases caused by microscopic *Fungi*.

In autumn, it is not uncommon to see flies, motionless upon a window-pane, with a sort of magic circle, in white drawn round them. On microscopic examination, the magic circle is found to consist of innumerable spores, which have been thrown off in all directions by a minute fungus called *Empusa musæ*, the spore-forming filaments of which stand out like a pile of velvet from the body of the fly. These spore-forming filaments are connected with others, which fill the interior of the fly's body like so much fine wool, having eaten away and destroyed the creature's viscera. This is the full-grown condition of the *Empusa*. If traced back to its earlier stages, in flies which are still active, and to all appearance healthy, it is found to exist in the form of minute corpuscles which float in the blood of the fly. These multiply and lengthen into filaments, at the expense of the fly's substance; and when they have at last killed the patient, they grow out of its body and give off spores. Healthy flies shut up with diseased ones catch this mortal disease and perish like the others. A most competent observer, M. Cohn, who studied

the development of the *Empusa* in the fly very carefully, was utterly unable to discover in what manner the smallest germs of the *Empusa* got into the fly. The spores could not be made to give rise to such germs by cultivation; nor were such germs discoverable in the air, or in the food of the fly. It looked exceedingly like a case of Abiogenesis, or, at any rate, of Xenogenesis; and it is only quite recently that the real course of events has been made out. It has been ascertained, that when one of the spores falls upon the body of a fly, it begins to germinate and sends out a process which bores its way through the fly's skin; this, having reached the interior cavities of its body, gives off the minute floating corpuscles which are the earliest stage of the *Empusa*. The disease is "contagious," because a healthy fly coming in contact with a diseased one, from which the spore-bearing filaments protrude, is pretty sure to carry off a spore or two. It is "infectious," because the spores become scattered about all sorts of matter in the neighbourhood of the slain flies.

The silkworm has long been known to be subject to a very fatal contagious and infectious disease called the *Muscardine*. Audouin transmitted it by inoculation. This disease is entirely due to the development of a fungus, *Botrytis Bassiana*, in the body of the caterpillar; and its contagiousness and infectiousness are accounted for in the same way as those of the fly-disease. But of late years a still more serious epizootic has appeared among the silkworms; and I may mention a few facts which will give you some conception of the gravity of the injury which it has inflicted on France alone.

The production of silk has been, for centuries, an important branch of industry in Southern France, and in the year 1853 it had attained such a magnitude, that the annual produce of the French sericulture was estimated to amount to a tenth of that of the whole world, and represented a money value of 117,000,000 of francs, or nearly five millions sterling. What may be the sum which would represent the money-value of all the industries connected with the working up of the raw silk thus produced is more than I can pretend to estimate. Suffice it to say that the city of Lyons is built upon French silk, as much as Manchester was upon American cotton before the civil war.

Silkworms are liable to many diseases; and, even before 1853, a peculiar epizootic, frequently accompanied by the appearance of dark spots upon the skin (whence the name of "Pébrine" which it has received), had been noted for its mortality. But, in the years following 1853, this malady broke out with such extreme violence, that, in 1856, the silk-crop was reduced to a third of the amount which it had reached in 1853; and, up till within the last year or two, it has never attained half the yield of 1853. This means not only that the great number of people engaged in silk-growing are some thirty millions sterling poorer than they might have been; it means not only that high prices have had to be paid for imported silkworm-eggs, and that, after investing his money in them, in paying for mulberry-leaves and for attendance, the cultivator has constantly seen his silkworms perish and himself plunged in ruin—but it means that the looms of Lyons have lacked employment, and that, for years, enforced idleness and misery have been the portion of a vast population which, in former days, was industrious and well to do.

In 1858, the gravity of the situation caused the French Academy of Sciences to appoint Commissioners, of whom a distinguished naturalist, M. de Quatrefages, was one, to inquire into the nature of this disease, and, if possible, to devise some means of staying the plague. In reading the Report\* made by M. de Quatrefages, in 1859, it is exceedingly interesting to observe that his elaborate study of the Pébrine, forced the conviction upon his mind that, in its mode of occurrence and propagation, the disease of the silkworm is, in every respect, comparable to the cholera among mankind. But it differs from the cholera, and, so far, is a more formidable disease, in being hereditary, and

\* "Etudes sur les Maladies Actuelles des Vers à Soie," p. 53.



in being, under some circumstances, contagious as well as infectious.

The Italian naturalist, Filippi, discovered, in the blood of the silkworms affected by this strange disease, a multitude of cylindrical corpuscles, each about 1-6000th of an inch long. These have been carefully studied by Lebert, and named by him *Panhistophyton*; for the reason that, in subjects in which the disease is strongly developed, the corpuscles swarm in every tissue and organ of the body, and even pass into the undeveloped eggs of the female moth. But, are these corpuscles causes or mere concomitants of the disease? Some naturalists took one view and some another; and it was not until the French Government, alarmed by the continued ravages of the malady, and the inefficiency of the remedies which had been suggested, dispatched M. Pasteur to study it, that the question received its final settlement; at a great sacrifice, not only of the time and peace of mind of that eminent philosopher, but, I regret to have to add, of his health.

But the sacrifice has not been in vain. It is now certain that this devastating, cholera-like, Pébrine is the effect of the growth and multiplication of the *Panhistophyton* in the silkworm. It is contagious and infectious because the corpuscles of the *Panhistophyton* pass away from the bodies of the diseased caterpillars, directly or indirectly, to the alimentary canal of healthy silkworms in their neighbourhood; it is hereditary, because the corpuscles enter into the eggs while they are being formed, and, consequently, are carried within them when they are laid; and for this reason, also, it presents the very singular peculiarity of being inherited only on the mother's side. There is not a single one of all the apparently capricious and unaccountable phenomena presented by the Pébrine, but has received its explanation from the fact that the disease is the result of the presence of the microscopic organism, *Panhistophyton*.

Such being the facts with respect to the Pébrine, what are the indications as to the method of preventing it? It is obvious that this depends upon the way in which the *Panhistophyton* is generated. If it may be generated by Abiogenesis, or by Xenogenesis, within the silkworm or its moth, the extirpation of the disease must depend upon the prevention of the occurrence of the conditions under which this generation takes place. But if, on the other hand, the *Panhistophyton* is an independent organism, which is no more generated by the silkworm than the mistletoe is generated by the oak on the apple-tree on which it grows, though it may need the silkworm for its development, in the same way as the mistletoe needs the tree, then the indications are totally different. The sole thing to be done is to get rid of and keep away the germs of the *Panhistophyton*. As might be imagined, from the course of his previous investigations, M. Pasteur was led to believe that the latter was the right theory; and, guided by that theory, he has devised a method of extirpating the disease, which has proved to be completely successful wherever it has been properly carried out.

There can be no reason, then, for doubting that, among insects, contagious and infectious diseases, of great malignity, are caused by minute organisms which are produced from pre-existing germs, or by Homogenesis; and there is no reason, that I know of, for believing that what happens in insects may not take place in the highest animals. Indeed, there is already strong evidence that some diseases of an extremely malignant and fatal character to which man is subject, are as much the work of minute organisms as is the Pébrine. I refer, for this evidence, to the very striking facts adduced by Professor Lister in his various well-known publications on the antiseptic method of treatment. It seems to me impossible to rise from the perusal of those publications without a strong conviction that the lamentable mortality which so frequently dogs the footsteps of the most skilful operator, and those deadly consequences of wounds and injuries which seem to haunt the very walls of great hospitals, and are, even now, destroying more men than die of bullet or bayonet, are due to the importation of minute organisms into wounds, and

their increase and multiplication; and that the surgeon who saves most lives will be he who best works out the practical consequences of the hypothesis of Redi.

I commenced this Address by asking you to follow me in an attempt to trace the path which has been followed by a scientific idea, in its long and slow progress from the position of a probable hypothesis to that of an established Law of Nature. Our survey has not taken us into very attractive regions; it has lain, chiefly, in a land flowing with the abominable, and peopled with mere grubs and mouldiness. And it may be imagined with what smiles and shrugs practical and serious contemporaries of Redi and of Spallanzani may have commented on the waste of their high abilities in toiling at the solution of problems which, though curious enough in themselves, could be of no conceivable utility to mankind.

Nevertheless, you will have observed that, before we had travelled very far upon our road, there appeared, on the right hand and on the left, fields laden with a harvest of golden grain, immediately convertible into those things which the most sordidly practical of men will admit to have value—viz., money and life.

The direct loss to France caused by the Pébrine in seventeen years cannot be estimated at less than fifty millions sterling; and if we add to this what Redi's idea, in Pasteur's hands, has done for the wine-grower and for the vinegar-maker, and try to capitalise its value, we shall find that it will go a long way towards repairing the money-losses caused by the frightful and calamitous war of this autumn.

And, as to the equivalent of Redi's thought in life, how can we over-estimate the value of that knowledge of the nature of epidemic and epizootic diseases, and, consequently, of the means of checking or eradicating them, the dawn of which has assuredly commenced?

Looking back no further than ten years, it is possible to select three (1863, 1864, and 1869) in which the total number of deaths from scarlet fever alone amounted to 90,000. That is the return of killed, the maimed and disabled being left out of sight. Why, it is to be hoped that the list of killed in the present bloodiest of wars will not amount to more than this! But the facts which I have placed before you must leave the least sanguine without a doubt that the nature and the causes of this scourge will, one day, be as well understood as those of the Pébrine are now; and that the long-suffered massacre of our innocents will come to an end.

And thus mankind will have one more admonition that "the people perish for lack of knowledge;" and that the alleviation of the miseries and the promotion of the welfare of men must be sought, by those who will not lose their pains, in that diligent, patient, loving study of all the multitudinous aspects of Nature, the results of which constitute exact knowledge, or Science.

It is the justification and the glory of this great Meeting that it is gathered together for no other object than the advancement of the moiety of Science which deals with those phenomena of Nature which we call physical. May its endeavours be crowned with a full measure of success!

#### Section B.

### ADDRESS TO THE CHEMICAL SECTION.

SEPTEMBER 15, 1870.

By Professor H. E. ROSCOE, Ph.D., F.R.S., President.

GENTLEMEN,—

In the midst of the excitement of the horrible war in which the two most scientific nations of the Continent are now plunged, let us endeavour to turn our thoughts into channels more congenial to the scientific inquirer; and



allow me to recount to you, as far as I am able, the peaceful victories which, since our last meeting in Exeter, have been achieved in our special department of chemistry. But first may I be permitted to draw your attention to the fact that whilst, on the one hand, we hear of professors of chemistry and their students volunteering in the humane offices of field apothecaries or hospital attendants, we learn, on the other hand, that a distinguished chemist has accepted the chairmanship of a scientific committee called together for the express purpose of employing all the resources of modern chemistry in the horrible destruction of their fellow creatures; for to what do such resources in the last instance amount, but to sudden explosion, fire, or poison? The application of such means in such an age as this cannot surely be justified in any sense either by patriotism or public duty. And yet, in spite of all this, it is, in my mind, mainly to the brotherly intercourse of those interested in science and in its applications to the arts and manufactures in different countries that we must look as the small but living fire, which, in the end, will surely serve to melt down national animosities, and to render impossible the breaking out of disasters so fatal to the progress of science and to the welfare of humanity as that of which we are now, unfortunately, the spectators.

With regard to the position of chemical science at the present moment, it will not take a careful observer long to see that, in spite of the numerous important and brilliant discoveries of which every year has to boast, we are really but very imperfectly acquainted with the fundamental laws which regulate chemical actions, and that our knowledge of the ultimate constitution of matter upon which those laws are based is but of the most elementary nature. In proof of this I need only refer to the different opinions expressed by our leading chemists, in a discussion which lately took place at the Chemical Society on the subject of the atomic theory. The president (Dr. Williamson) delivered a very interesting lecture, in which the existence of atoms was treated as "the very life of chemistry." Dr. Frankland, on the other hand, states that he cannot understand action at a distance between matter separated by a vacuous space; and, although, generally granting that the atomic theory explains chemical facts, yet he is not to be considered as a blind believer in the theory, or as unwilling to renounce it if anything better presented itself. Sir B. C. Brodie and Dr. Odling both agree that the science of chemistry neither requires nor proves the atomic theory; whilst the former points out that the true basis of this science is to be sought in the investigation of the laws of gaseous combination or the study of the capacity of bodies for heat, rather than in committing ourselves to assertions incapable of proof by chemical means. Agreeing in the main myself with the opinions of the last chemists, and believing that we must well distinguish between fact and theory, I would remind you that Dalton's discovery of the laws of multiple and reciprocal proportions—I use Dr. Odling's word—as well as the differences in the power of hydrogen replacement in hydrochloric acid, water, ammonia, and marsh gas, are facts, whilst the explanation upon the assumption of atoms is, as far as chemistry is as yet advanced, a theory. If, however, the existence of atoms cannot be proved by chemical phenomena, we must remember that the assumption of the atomic theory explains chemical facts as the undulatory theory gives a clear view of the phenomena of light. Thus, for instance, one of the most important facts and relations of modern chemistry which it appears difficult, if not impossible, to explain without the assumption of atoms, is that of isomerism. How, otherwise than by a different arrangement of the single constituent particles, are we to account for several distinct substances in which the proportions of carbon, hydrogen, and oxygen are the same? Why, for instance, should forty-eight parts by weight of carbon, ten of hydrogen, and sixteen of oxygen united together, be capable of existing as three different chemical sub-

stances unless we presuppose a different statical arrangement of the parts by which these differences in the deportment of the whole are rendered possible? If, then, it be true that chemistry cannot give us positive information as to whether matter is infinitely divisible, and therefore continuous, or consists of atoms and is discontinuous, we are in some degree assisted in this inquiry by deductions from physical phenomena which have been recently pointed out by the genius of Sir William Thomson. He argues from four different classes of physical phenomena, and comes to the conclusion, not only that matter is discontinuous, and, therefore, that atoms and molecules do exist, but he even attempts to form an idea of the size of these molecules, and he states that in any ordinary liquid, transparent or seemingly opaque solid, the mean distance between the centres of contiguous molecules is less than the hundred millionth, and greater than the two-thousand millionth of a centimetre. Or, to form a conception of this coarse-grainedness, imagine a rain-drop or globe of glass as large as a pea, to be magnified up to the size of the earth, each constituent molecule being magnified in the same proportion; the magnified structure would be coarser-grained than a heap of small shot, but probably less coarse-grained than a heap of cricket balls.

There is, however, another class of physical considerations which render the existence of indivisible particles more than likely. I refer to the mechanical theory of gases by means of which, thanks to the labours of eminent English and German philosophers, all the physical properties of gases, their equal expansion by heat, the laws of diffusion, the laws of alteration of volume under pressure, can be shown to follow from the simple laws of mechanical motion. This theory, however, presupposes the existence of molecules, and in this direction again we find confirmation of the real existence of Dalton's atoms. Indeed, it has been proved that the average velocity with which the particles of oxygen, nitrogen, or common air are continually projected forward, amounts, at the ordinary atmospheric pressure, to 50,000 centimetres per second, whilst the average number of impacts of each of these molecules is 5000 millions per second. The mention of the molecular motions of gases will recall to the minds of all present the great loss which English science has this year sustained in the death of the discoverer of the laws of gaseous diffusion. Throughout his life Graham's aim was the advancement of our knowledge in the special subject of the molecular properties of gases. With this intent he unceasingly laboured up to the moment of his death, in spite of failing health and pressure of official business, unfolding for posterity some of the most difficult as well as the most interesting secrets of nature in this branch of our science. "What do you think," he writes to Hofmann, "of metallic hydrogen, a white magnetic metal?" And yet now, through his labours, the fact of the condensation of hydrogen in the solid state by metallic palladium, and to a less extent by other metals, has become familiar to all of us. Then, again, I would remind you of Graham's recent discovery of the occlusion of hydrogen gas in certain specimens of meteoric iron, whilst earth-manufactured iron contains not hydrogen but absorbed carbonic oxide gas, proving that the meteorite had probably been thrown out from an atmosphere of incandescent hydrogen existing under very considerable pressure, and therefore confirming in a remarkable degree the conclusions to which spectrum analysis had previously led us. The position in the ranks of British science left by Graham's death will not be easily filled up; he accomplished to a certain extent for dynamical chemistry what Dalton did for statical chemistry, and it is upon his experimental researches in molecular chemistry that Graham's permanent fame as one of England's greatest chemists will rest.

As closely connected with the above subjects, I have next to mention a most important research by Dr. Andrews, of Belfast, which, marking an era in the history of gases,



shows us how our oldest and most cherished notions must give way before the touchstone of experiment. No opinion would appear to have been more firmly established than that of the existence of three separate states or conditions of matter, viz., the solid, the liquid, and the gaseous. A body capable of existing in two or more of these states was thought to pass suddenly from one to the other by absorption or emission of heat, or by alterations of the superincumbent pressure. Dr. Andrews has shown us how false are our views on this fundamental property of matter; for he has proved that a large number of, and probably all, easily condensable gases or vapours possess a critical point of temperature at and above which no increase of pressure can be made to effect a change into what we call the liquid state, the body remaining as a homogeneous fluid; whilst below this critical temperature certain increase of pressure always effects a separation into two layers of liquid and gaseous matter. Thus, with carbonic acid, the point of critical temperature is  $30.92^{\circ}\text{C.}$ , and with each given substance this point is a specific one, each vapour exhibiting rapid changes of volume and flickering movements when the temperature or pressure was changed, but showing no separation into two layers. Under these circumstances, it is impossible to say that the body exists either in the state of a gas or of a liquid; it appears to be in a condition intermediate between the two. Thus, carbonic acid, under the pressure of 108 atmospheres, and at  $35.5^{\circ}\text{C.}$ , is reduced to the 1-430th of the volume which it occupies at one atmosphere, it has undergone a regular and unbroken contraction, and it is a uniform fluid: if we now reduce the temperature below  $31^{\circ}\text{C.}$  the liquid condition is assumed without any sudden change of volume or any abrupt evolution of heat. We can scarcely too highly estimate the value of the researches of Andrews.

As examples of the power which modern methods of research give of grappling with questions which only a few years ago were thought to be insoluble, I may quote the beautiful observations, now well known, by which Lockyer determined the rate of motion on the sun's surface, together with those of Frankland and Lockyer respecting the probable pressure acting in the different layers of the solar atmosphere; and lastly, the results obtained by Zöllner, respecting solar physics, and especially the probable absolute temperature of the sun's atmosphere, as well as that of the internal molten mass. These last results are so interesting and remarkable as being arrived at by the combination of recent spectroscopic observation with high mathematical analysis, that I may perhaps be permitted shortly to state them. Starting from the fact of the eruptive nature of a certain class of solar protuberances, Zöllner thinks that the extraordinary rapidity with which these red flames shoot forth proves that the hydrogen of which they are mainly composed must have burst out from under great pressure; and if so, the hydrogen must have been confined by a zone or layer of liquid from which it breaks loose. Assuming the existence of such a layer of incandescent liquid, then applying to the problem the principles and methods of the mechanical theory of gases, and placing in his formulæ the data of pressure and rate of motion as observed by Lockyer on the sun's surface, Zöllner arrives at the conclusion that the difference of pressure needed to produce an explosion capable of projecting a prominence to the height of 3.0 minutes above the sun's surface, a height not unfrequently noticed, is 4,070,000 atmospheres. This enormous pressure is attained at a depth of 139 geographical miles under the sun's surface, or at that of 1-658th part of the sun's semi-diameter. In order to produce this gigantic pressure the difference in temperature between the enclosed hydrogen and that existing in the solar atmosphere amounts to  $74,910^{\circ}\text{C.}$  In a similar way Zöllner calculates the approximate absolute temperature of the sun's atmosphere, which he finds to be  $27,700^{\circ}\text{C.}$ —a temperature about eight times as high as that given by Bunsen for the oxyhydrogen flame, and

one at which iron must exist in a permanently gaseous form.

Passing on to more purely chemical subjects, we find this year signalled by the re-determination of a most important series of chemical constants, viz., that of the heat of chemical combination, by Julius Thomsen, of Copenhagen. This conscientious experimentalist asserts that the measurements of the heat evolved by neutralising acids and bases hitherto considered most correct, viz., those made with a mercury calorimeter by Favre and Silbermann, differ from the truth by 12 per cent, whilst the determination by these experimenters of the heat of solution of salts is frequently 50 per cent wrong. As the result of his numerous experiments, Thomsen concludes that when a molecule of acid is neutralised by caustic alkali the heat evolved increases nearly proportionally to the quantity of alkali added until this reaches 1,  $\frac{1}{2}$ ,  $\frac{1}{3}$ , or  $\frac{1}{4}$  of a molecule of alkali, according as the acid is mono-, di-, tri-, or tetra- basic. Exceptions to the law are exhibited by silicic, and also partly by boracic, orthophosphoric, and arsenic acids. In the two latter the heat of combination is proportional for the two first atoms of replaceable hydrogen, but much less for the third atom. A second unexpected conclusion which Thomsen draws from his calorific determinations is that sulphuretted hydrogen is a mono-basic acid, and that its rational formula is therefore HSH.

Another important addition made to chemistry since our last meeting is a new, very powerful, and very simple form of galvanic battery, discovered, though not yet described, by Bunsen. In this second Bunsen's battery only one liquid, a mixture of sulphuric and chromic acids, and, therefore, no porous cells, are employed. The plates of zinc and carbon can all be lowered at once into the liquid and raised again at will. The electromotive force of this battery is to that of Grove—the most powerful of known forms—as 25 to 18; it evolves no fumes in working, and can be used for a very considerable length of time without serious diminution of the strength of the current, so that Bunsen writes me that no one who has once used the new battery will ever think of again employing the old forms. I had hoped to be able to exhibit to the section this important improvement in our means of producing a strong current, but war has demanded the use of other batteries, and Bunsen has been unable to send me a set of his new cells.

Amongst the marked points of interest and progress in inorganic chemistry during the past year, we have to notice the preparation of a missing link amongst the oxy-sulphur acids by Schützenberger. It is the lowest known, and may be called hydrosulphurous acid,  $\text{H}_2\text{SO}_2$ . The sodium salt,  $\text{NaHSO}_2$ , is obtained by the action of zinc on the bisulphite; as might be expected, it possesses very powerful reducing properties, and bleaches indigo rapidly. The metallic vanadates have also been carefully examined, and the existence of three distinct series of salts proved, corresponding to the phosphates, viz., the ortho or tribasic vanadates, the pyro or tetrabasic vanadates, and the meta or monobasic vanadates. Of these the ortho salts are most stable at a high temperature, whilst, at the ordinary atmospheric temperature, the meta salts are most stable. In the phosphorus series, as is well known, the order of stability is the reverse; and thus the points of analogy and of difference between phosphorus and vanadium become gradually apparent.

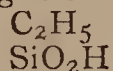
As an illustration of the results of modern organic research—for in viewing the year's progress in this ever widening branch of chemistry it is impossible to do more than give a few illustrations—I may quote Baeyer's remarkable investigations on mellitic acid. Originally discovered by Klaproth in honeystone or mellite (a substance which yet remains the only source of the acid), mellitic was supposed to be a four-carbon acid. Baeyer has quite recently shown that the acid contains twelve atoms of carbon, or has a molecular weight three times as great as was originally supposed. He has shown that mellitic acid is benzohexacarbonic acid,  $\text{C}_{12}\text{H}_6\text{O}_{12}$ , or



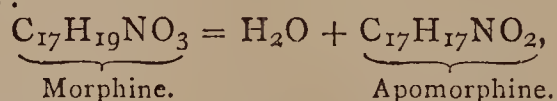
benzol in which the six atoms of hydrogen are replaced by the monad radical, carboxyl (COOH); as benzoic is benzol-mono-carbonic acid, or benzol in which one of hydrogen is replaced by carboxyl. The most interesting portion of Baeyer's research, however, lies in the intermediate acids, partly new and partly acids already prepared, which he has shown lie between mellitic and benzoic acid, and in which from one to six atoms of hydrogen in benzol are respectively replaced by carboxyl. Nor is this all, for he has proved that, with two exceptions, each of these six acids is capable of existing in three isomeric modifications, thus giving us an insight into the arrangement of the molecule of these aromatic compounds. For the simplest mode of explaining these numerous isomers is that given by Baeyer in the different order in which the several atoms of hydrogen in the benzol molecule are replaced. Thus, in the first, or ortho, series, the hydrogen atoms in benzol, being numbered in regular succession, are replaced in the same regular succession; in the second, or meta, series, the order is 1, 2, 3, 5, &c.; whilst the third, or para, series, take open order, as 1, 2, 4, 5, &c. Thus we have—

	Ortho series.	Para series.	Meta series.
$C_{12}H_6O_{12}$ Hexabasic	{ Mellitic or Benzohexacarmonic.		
$C_{11}H_6O_{10}$ Penta ..		Unknown.	
$C_{10}H_6O_8$ Tetra ..	{ Pyromellitic or Benzotetracarmonic.	Isopyromellitic.	Unknown.
$C_9H_6O_6$ Tri ..	{ Trimesinic or Benzotricarmonic.	Hemimellitic.	Trimellitic.
$C_8H_6O_4$ Di ..	{ Phthalic or Benzodiacarmonic.	Isophthalic.	Tetraphthalic.
$C_7H_6O_2$ Mono..	{ Benzoic or Benzolmonocarmonic.		

Amongst the most interesting series of new organic bodies are those in which tetrad silicon partly replaces carbon. Our knowledge of these substances is gradually becoming more complete; the last new member prepared by Friedel and Ladenburg is silico-propionic acid—



the first of a series of carbo-silicic acids containing the radical  $SiO_2H$ . The interesting researches of Matthiessen and Wright on morphine and codeine have thrown a new light on the constitution of these opium alkaloids. Treated with hydrochloric acid morphine loses one molecule of water, and gives rise to a new base called apomorphine, thus:—



which differs in a remarkable manner from morphine, both in its chemical and physiological actions, being soluble in alcohol, ether, and chloroform, whereas morphine is nearly insoluble, and acting as the most powerful emetic known, one-tenth of a grain producing vomiting in less than ten minutes. Codeine, which only differs from morphine by  $CH_2$  also yields apomorphine on treatment, at a high temperature with hydrochloric acid, methyl chloride being at the same time eliminated.

An important application of the dehydrating and carbon condensing power of zinc chloride, long known in its action on alcohol to produce ether, has been made by Kekulé in the reduplication of aldehyde to form croton aldehyde with loss of water— $2(C_2H_4O) - H_2O = C_4H_6O$ . This croton aldehyde is also probably formed as an intermediate product in the manufacture of chloral from aldehyde, and gives rise to the formation of croton chloral,  $C_4H_3Cl_3O$ .

The discovery of the sedative properties of chloral hydrate by Liebreich marks an era in medical chemistry second only to the discovery of the anæsthetic properties of chloroform. Chloral not only combines with water to form a solid hydrate but also forms solid alcoholates; but these bodies appear to possess quite different medicinal properties from the hydrate, and it is important that no alcoholate should be present in the official preparation.

The chemistry of colouring matters has lately received

an enormous impetus in the practical working of the brilliant discovery of the production of artificial alizarine, the colouring matter of madder, by Messrs. Graebe and Liebermann. This discovery, announced at our last meeting, is of the highest importance—whether we regard its scientific interest or its practical and commercial value—and it differs from all the former results which have been brought about by the application of science to the production of colouring matter, inasmuch as this has reference to the artificial production of a natural vegetable colouring substance, which has been used as a dye from time immemorial, and which is still employed in enormous quantities for the production of the pink, purple, and black colours which are seen everywhere on printed calicoes. During the past year much progress has been made in the practical working of the processes by which this colouring matter is obtained from the hydrocarbon anthracene contained in coal tar, and new and more economical plans for effecting the transformation have been independently proposed by Perkin and Caro, and Schorlemmer and Dale. The theoretical investigation of the reaction—and especially of the nature of some other peculiar products formed in addition to alizarine, which render the artificial colouring matter different from natural alizarine—has been carried out by Mr. Perkin, and especially by Dr. Schunck. As we are promised papers on this subject from both these gentlemen, I need not at present enter further into these interesting questions.

The surest proof of perfection in a manufacture is the degree in which the waste products are utilised, and in which the processes are made continuous. One by one the imperfections of the original discovery are made to disappear, and the products which were wasted become sources of profit, whilst in many cases their utilisation alone renders possible the continuance of the manufacture in the midst of a rapidly increasing district. The section will have the opportunity of inspecting the practical working of at least two of the most valuable of these new processes which have lately been introduced into our most important chemical manufacture—that of alkali. The first of these has been at work for some time, it is that of the recovery of sulphur from the vat waste, that *bête noir* of the alkali makers and of their neighbours. Dr. Mond has now, I believe, satisfactorily solved the difficult problem of economically regaining the sulphur by oxidising the insoluble monosulphide of calcium in the lixiviating vat itself to the soluble hyposulphite, and decomposing this by hydrochloric acid when all the sulphur is deposited as a white powder. The second of these discoveries relates to the recovery or regeneration of the black oxide of manganese used for the evolution of chlorine in the manufacture of bleaching powder. This subject has long attracted the attention of chemists, and a feasible, though somewhat costly, process, that of Dunlop, has been at work for some time at Messrs. Tennant's work at St. Rollox. During the last year a very beautifully simple and economical process proposed by Mr. Weldon, and first successfully carried out on a practical scale at Messrs. Gamble's works at St. Helens, has quickly obtained recognition, and is now worked by more than thirty-seven firms throughout the kingdom. The principle upon which this process depends was explained by Mr. Weldon at the Exeter meeting. It depends on the fact that although when alone the lower oxides of manganese cannot be oxidised by air and steam under the ordinary pressure to the state of bioxide, yet that this is possible when one molecule of lime is present to each molecule of oxide of manganese. The manganous oxide is precipitated from the still liquors with the above excess of lime, and by the action of steam and air on this, a black powder, consisting of a compound of manganese, dioxide and lime,  $MnO_2CaO$ , or calcium manganite, is formed. This, of course, is capable of again generating chlorine on addition of hydrochloric acid, and thus the chlorine process is made continuous with a working loss of only  $2\frac{1}{2}$  per cent of manganese. The section will have the advantage of seeing Mond's



process at work at Messrs. Hutchinson's, and Weldon's process at Messrs. Gaskell, Deacon, and Co., at Widnes. A third process, which may possibly still further revolutionise the manufacture of bleaching powder, is the direct production of chlorine from hydrochloric acid without the use of manganese at all. In presence of oxygen and of certain metallic oxides, such as oxide of copper, hydrochloric acid gas parts at a red heat with all its hydrogen, water and chlorine being formed. This interesting reaction is employed by its discoverer, Mr. Deacon, for the direct manufacture of bleaching powder from the gases issuing directly from the salt-cake furnace. Air is admitted together with hydrochloric acid gas, and the mixture is passed over red-hot bricks, impregnated with copper salt. The oxide of copper acts as by contact and remains unaltered, whilst the chlorine, watery vapour, and excess of air pass at once into the lime chamber. There are many practical difficulties in working this process, some of which have still to be overcome, but I believe we shall hear from Mr. Deacon that, notwithstanding this drawback, he has accomplished his end of making good bleaching powder by this process.

### GERMAN CHEMICAL SOCIETY OF BERLIN.

THE Editor has just received the following letter and communication from Dr. Hofmann. No introductory remarks from us are needed to urge the vital importance of a liberal and speedy response to this appeal of the German chemists to their English brethren.

MY DEAR MR. CROOKES,—Could you find space for the annexed appeal in your columns. If you were to introduce the subject by some prefatory remarks, you would greatly oblige—Yours most sincerely,

A. W. HOFMANN.

Berlin, September 11th, 1870.

The encampments of our armies in the present war; the fortresses where enormous numbers of troops, many of them badly fed and wounded, are crowded within spaces altogether inadequate; the hospitals, lastly, which, to satisfy the pressing demand, are rapidly being established all over Germany, Alsace, and Lorraine, are apt to become the hotbeds of all sorts of contagious poison. A host of new enemies threaten to arise from these places, in the form of fever and diseases of every description; and to the sudden terror of battle will be added the formidable burden of protracted suffering, unless the precautionary measures which science suggests be adopted with the utmost speed and to the fullest extent.

Animated by the desire to avert, as far as possible, such calamities, the Council of the German Chemical Society of Berlin have associated themselves with the Central Committee for the Relief of Sick and Wounded Soldiers in the Field, and now appeal to all chemical manufacturers for help in procuring an early supply of disinfectants on a very scale.

With the view of accomplishing this object, the Council of the German Chemical Society venture to hope that also many of the British manufacturers may feel disposed to co-operate with them, by placing at their disposal, either in one delivery or by regular instalments, a supply of the undermentioned disinfectants.

By order of the Council,

A. W. HOFMANN.

All communications to be addressed to Professor Hofmann, care of Dr. Wichelhaus, 33, Georgen Str., Berlin.

#### List of Disinfectants.

1. Liquid residues of the manufacture of chlorine.
2. Chloride of lime.
3. Green vitriol.
4. Permanganate of potash.
5. Carbolic acid (crude and purified).

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

*Under this heading will be found an encyclopaedic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

*Comptes Rendus des Séances de l'Académie des Sciences*, September 5, 1870.

Most of the original memoirs and papers published in this number refer to natural history and mathematical subjects; those relating to physico-chemical matters are the following:—

**Mariotte's Theory of Barometrical Oscillations.**—W. de Fonvielle.—The author states that, at page 161 of the first volume of the "Oeuvres de Mariotte," published at Paris in 1740, the following ingenious theory is propounded, with the view to explain why the mercury in a barometer-tube rises with a prevailing northerly wind, and falls when it blows from the south-east. "The action of the north and north-east wind is not simply due to the fact that they render the air heavier (no doubt in consequence of its contraction by cold—W. de F.), but also because they blow against the globe, in the direction of from top to bottom; and, by thus compressing the air, increase its elasticity, whereby the mercury is lifted up. The barometric oscillations which are observed when a southerly or south-west wind prevails are explained on an analogous principle, viz.:—The south and south-west winds coming from afar blow towards the globe in a tangential direction, thereby lifting the upper layers of the air, and consequently diminishing its elasticity below, and thereby causing the mercury in the barometer-tube to fall."

**Chemical Composition of Nadorite.**—M. Flajolot.—The author has made a new series of analyses of this mineral, which he now finds to have the following per cental composition:—Lead, 51.60; antimony, 32.25; oxygen, 8.00; chlorine, 8.85. Formula,  $\text{Sb}_2\text{O}_2\text{Cl}_2\cdot 2\text{PbO}$ . The mineral may be considered to consist of a combination of oxide of lead and oxychloride of antimony—viz., 55.6 of oxide of lead and 43.4 of oxychloride of antimony,  $\text{Sb}_2\text{O}_2\text{Cl}$ .

**Essay on the Venom of Scorpions.**—Dr. Jousset.—This lengthy memoir contains the detailed account of a series of experiments on the venom of the *Scorpio occitanus*, a rather common *Arachnida* in Southern Europe. The author draws, from his experiments, the following conclusions:—The venom of the *Scorpio occitanus* acts directly and solely upon the red blood globules. This action consists in withdrawing from the globules their property of gliding over each other. By losing this property, the blood globules become glued together, and, by thus becoming an adhesive mass, obstruct the circulation of blood in the capillary portion of the vascular system, thereby causing a stasis which is altogether incompatible with the proper conditions of life. The author also observes that, since the action of the scorpion's venom is purely chemical, and that a certain quantity of it (the venom) is required for exerting its action, it essentially differs from virus, which acts as a ferment.

**Gunpowder Prepared with Chlorate of Potassa.**—M. Zaliwski.—The author proposes to render this powder fit for fire-arms, by mixing with it some finely-pulverised oxalic acid. The manufacture of gunpowder wherein, instead of the whole or part of the nitre, chlorate of potassa was introduced was tried in France as far back as the year 1788, at Essone, by the advice of M. Berthollet; but, at the first trial of mixing the materials (sulphur, charcoal, and chlorate of potassa), a tremendous explosion took place, whereby several people were killed. Afterwards (1793), some of this powder was successfully prepared, and tried in fire-arms, but it was found to be dangerous, in consequence of its great tendency to explode, by slight concussion even; and its action is comparable to that of the fulminates, which, as is well known, are not at all suitable to serve as substitutes for powder. The author's idea of rendering chlorate of potassa gunpowder fit for use, by the addition of pulverised oxalic acid, will be further investigated by a committee of scientific men.

*Moniteur Scientifique*, No. 329, September 1, 1870.

This number contains the following original matter relating to chemistry and collateral sciences:—

**Detection of Strychnia in Medico-Forensic Analysis.**—Dr. Weyrich.—The author relates, at great length, a case of poisoning, with strychnia, of a person accustomed to consume opium, and to whom had been given large doses of ipecacuanha, while, moreover, a portion of the contents of the intestines had to be tested for mineral poisons. The real bearing, therefore, of this case turns upon the detection of strychnia in the presence of emetine and morphia. The strychnia was detected in an alcoholic extract of the materials taken from the corpse, by means of the reaction produced by strong sulphuric acid and bichromate of potassa, which at first oxidises only the emetine, and, this having been removed, produces the well-known purple coloura-



tion, due to the action of the bichromate and sulphuric acid upon strychnia. The morphia was detected in a separately-made amylic alcoholic solution, by means of molybdate of soda in dissolved concentrated sulphuric acid.

**Detection of the Adulteration of Quinine with Salicine.**—Dr. Sonelén.—The author has comparatively tested the degree of accuracy and sensitiveness of the different tests in use for the detection of the presence of salicine in quinine, which, if made with the view of fraudulent adulteration, will always be at least at the rate of 1 per cent of salicine, or more, because less will not pay. The author employed three kinds of sulphuric acid—viz., the fuming, pure concentrated acid, free from arsenic and nitric acid; ordinary concentrated sulphuric acid of commerce, containing a trace of nitric acid; and, lastly, sulphuric acid to which, purposely, nitric acid had been added. A watch-glass having been placed on a sheet of white paper, and a drop or two of the acids above referred to (each in a separate glass) having been poured therein, a few crystals of the alkaloid (sulphate of quinine) were put on the acid; if pure, there is no colouration, but, even with 1-100th of salicine, the three first-named acids caused a distinct red colouration, which did not ensue with the acid containing nitric acid. This latter acid was not even coloured by pure salicine.

**Permeability of the Skin for Liquids.**—Dr. Bloch.—The author describes a series of experiments made with divers fluids, none of which could exert any chemical or physical action upon the skin. Bordeaux wine, having been experimented with, was found to have penetrated the skin of the arm, washed and wiped dry, after it had been immersed for one hour in the wine, since, on washing the arm with a weak solution of perchloride of iron, the skin was black-coloured, owing to the formation of a tannate. The author seems to have forgotten that the permeability of the skin for liquids is employed in medicine as a therapeutic agent. We recollect the case of a lady who bathed in chicken broth twice daily, for therapeutic purposes; and milk, also, is in this way introduced into, and absorbed by, the system.

*Zeitschrift für Chemie von Beilstein, No. 13, 1870.*

This number contains the following original papers and memoirs:—

**Analysis of the Water of Two Mineral Springs situated in the Neighbourhood of Cairo (Egypt).**—Dr. C. Bender.—Water from Ain-Syra contains, in 1000 grms., 11.892 grms. of solid matter and 0.048 grms. of free carbonic acid gas. The solid matter, in grammes, is—Chloride of calcium, 0.150; chloride of magnesium, 1.850; chloride of sodium, 5.963; sulphate of lime, 0.500; sulphate of magnesia, 3.420; carbonate of lime, 0.004; carbonate of protoxide of iron, 0.005; traces of alumina and organic matter. Water from Hélonan; temperature, 29°; yield, 60 cubic metres in twenty-four hours. 1000 grms. contain:—Gases—Sulphuretted hydrogen, 0.044; free carbonic acid, 0.012; nitrogen, a trace. Solid substances, in grms.—Chloride of calcium, 0.180; chloride of magnesium, 1.820; chloride of sodium, 3.200; sulphate of lime, 0.024; carbonate of lime, 0.050; organic matter, a trace.

**Action of Pentabromide of Phosphorus upon Azoxybenzide.**—A. Werigo.—The author, desirous of substituting bromine for the oxygen contained in azoxybenzide, caused pentabromide of phosphorus to act upon azoxybenzide, and obtained (care being taken to moderate the violence of the reaction which takes place) a yellow-coloured crystalline substance,  $C_{12}H_{10}N_2Br_3$ . This body is, however, very unstable, so that it is even partly decomposed while being dissolved in sulphide of carbon, as well as in alcohol. By careful manipulation, the author was enabled to ascertain that the body referred to fuses at 70°, and then becomes deep red-coloured, but, on cooling reassumes its former yellow colour. Finely-divided silver withdraws the bromine from this compound, leaving azobenzid.

**On Brom-Benzol-Sulphochloride, its Derivatives; and on the Position Hydrogen Occupies in Benzol.**—H. Hübner and L. Alsberg.—The authors describe—Brombenzol-sulphochloride,  $C_6H_4BrSO_2Cl$ , a beautifully-crystalline compound, fusing at about 76°. Monobrombenzol-sulphohydrate,  $C_6H_4BrSH$ ; volatile when carried by steam; soluble in boiling alcohol; crystalline akin to naphthaline; fuses at 75°; precipitated from its alcoholic solution by acetate of lead. Monobrombenzol-disulphide—

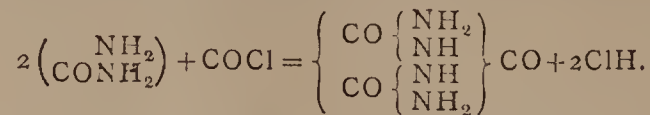


fuses at 93.5, is very difficultly soluble in alcohol, and not precipitated by acetate of lead. Benzol-sulphohydrate,  $C_6H_5SH$ ; a liquid boiling at about 167°; highly refracting light; smelling like mercaptan.

**Sulpho-Acids and Sulpho-Hydrates derived from Crystallised Bromotoluol.**—H. Hübner and J. Post.—This paper contains a lengthy enumeration of  $\alpha$ ,  $\beta$ , and  $\gamma$  series of sulpho-salts of bromotoluol, and the lengthy review of the toluol-sulpho hydrates obtained from  $\alpha$  and  $\beta$  bromotoluolsulphoacid.

**Preparation of Naphthæ Acid on the Large Scale.**—V. Merz and H. Mühlhäuser.—The authors describe, at great length, a series of experiments, chiefly instituted with the view to obtain naphthæ acid by a cheap and expedient process readily executable on the large scale, so as to produce, from naphthaline, the acid referred to, in sufficient quantities to employ that acid industrially instead of benzoic acid. The process of preparation is, briefly, the following:—Sulphonaphthalates, best alkaline, are distilled with cyanide of potassium, and the product of that distillation is saponified, yielding about four-fifths of its weight of naphthæ acid, which, however, requires a rather lengthy and tedious process of purification.

**Preliminary Notice on the Action of Phosgen upon some of the Amides.**—E. Schmidt.—When fluid phosgen acts, at 100°, upon urea, there is obtained a compound which the author calls carbonyldicarbamide, according to the formula—



When this body is again heated, along with phosgen, up to 160°–170°, there is formed dicyanic acid; when phosgen acts upon benzamide, at about 165°, there are formed benzoyl-chloride, benzo-nitrile, kyaphenin, carbonic acid, and chloride of ammonium.

**On Allyl-Cyanide.**—A. Rinne and B. Tollens.—The authors confirm the statements made by MM. Kekulé, Gautier, and others, as regards the reaction which takes place when chloride of allyl, dissolved in allylic alcohol, is put, along with cyanide of potassium, in a sealed tube, and heated to 100°. When the chloride of allyl, not in allylic alcoholic solution, is heated, in a sealed tube, to a higher temperature, a fluid is obtained which boils between 100° and 120°, but which has not been further investigated, since the authors only operated upon small quantities of material, and intend extending and continuing these researches.

**New Derivatives from Toluol.**—A. Heyneman.—The author describes paraiodmeta-nitrotoluol, nitrate of paraiodmeta-toluidine, parabrommeta-toluidine, binitro-iodkresol, and parabrom-nitrotoluol.

*Polytechnisches Journal von Dingler, second number for July, 1870.*

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

**Power of Electro-Magnets for Lifting Weights.**—Dr. A. von Waltenhofen.—The author describes a series of experiments, instituted with the view of elucidating the question of the hitherto-conflicting results obtained in reference to the relation the lifting power of an electro-magnet bears to the force of the electric current. The experiments made by the author lead to the result that a retention, or keeping back, of lifting power, after the electric current has ceased to act, does set in with forces of currents which are within the limits of the Lenz-Jacobi's law; while, on the other hand, a forerunning (Vozeilen) of lifting power is limited to, comparatively, very weak currents.

**Electro-Magnetic Behaviour of Discontinuous Masses of Iron; and—**

**Description of an Apparatus for Demonstrating the Magnetical Behaviour of Iron Tubes.**—By the same author as the first-named paper—Are memoirs illustrated with engravings.

**Contribution to the History of Continuous Annular-Shaped Brick-Kilns.**—P. Loeff.—With engravings.

**Santorin Earth.**—Dr. G. Feichtinger.—The material known as Santorin earth is a native product of the Island of Santorin, situated in the Mediterranean Sea, and part of the Greek territory. This earth, dried at 100°, consists, in 100 parts, of:—*a.* (substances soluble in water)—Sulphate of lime, 0.05; chloride of sodium, 0.05. *b.* (soluble in hydrochloric acid)—Alumina, 1.36; peroxide of iron, 1.41; lime, 0.40; magnesia, 0.23; silica, 3.40. *c.* (insoluble in hydrochloric acid)—Silica, 66.37; alumina, 12.36; peroxide of iron, 2.90; lime, 2.58; magnesia, 1.06; potassa, 2.83; soda, 4.22; water (only eliminable at low red heat), 4.06—Total, 99.83. The substance alluded to is used, along with lime, to form an excellent hydraulic cement; and the bulk of the contents of this paper are devoted to quote a series of researches bearing upon the subject of the hydraulic cements.

**Estimation of Sulphur, Phosphorus, and Silicium present in Pig-Iron.**—Dr. E. Richters.—This paper contains a comparative review of the relative values of the methods of Lippert and Gintl for the quantitative estimation of the substances referred to. The methods alluded to are fully described in the last edition of Fresenius's excellent work. The result of the author's researches is that Gintl's method is excellent for sulphur and phosphorus, but gives the silicium rather too low.

**Manufacture of Spirit from Moss and Lichens.**—S. Stenberg and T. Stahlschmidt.—This subject is by no means unimportant, since it may lead to the substitution for grain (if not completely, at least partly), as spirit-yielding material, of the abundance of mosses and lichens found in wild state on land, as well as in the sea. This lengthy paper contains a full description of the process of converting the cellulose and starch present in the raw materials into glucose.

**Preparation of Beer so as to make it Fit for Long Journeys by Sea.**—Dr. E. Dingler.—This essay is illustrated with engravings.

**Spontaneous Combustion of Black-Dyed Silk.**—Dr. E. Dingler.—A short time ago, a fire broke out at the premises of MM. Behague and Paxer, Paris, who are wholesale silk mercers; the fire was, however, very quickly discovered, and this gave rise to the discovery that it originated inside a large parcel of black-dyed silk which had been returned from the dye-house only twenty-four hours previously. That black-dyed silk is rather liable to spontaneous combustion, has been a well-known fact for years, but, notwithstanding the researches of Persoz and others on this subject, the real cause is not quite elucidated. It is advisable, however, not to keep large quantities of black-dyed silk together, and, also, to prevent it getting very dry; and, above all, care should be taken to prevent it being exposed to any great degree of heat, while proper ventilation among the parcels should be also attended to.



# THE CHEMICAL NEWS.

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## ON THE MANUFACTURE OF CHLORINE.\*

By WALTER WELDON.

At the meeting of this Section at Exeter, last year, I had the honour to describe a process for the manufacture of chlorine by means of a perpetually regenerated reagent consisting mainly of a previously unknown compound containing the elements of peroxide of manganese and lime. At that time the process in question was at work only at two places. It had been in operation for about a year at the works of Lieut.-Colonel Gamble, at St. Helens, at whose works, and by whose very generous co-operation, the process had been wrought out; and it has just begun to be adopted by Messrs. Gaskell, Deacon, and Co., at Widnes. It is now in operation at ten works in this country; in a few weeks it will be in operation in sixteen works in this country; at eight or nine other works in this country the erection of plant for it has either already begun or is on the point of beginning; with the exception of a very few of the very smallest, every British manufacturer of chlorine has taken a licence for the use of it; the principal continental manufacturers have done the same; and large plants for it are already completed both in France and in Germany, and, although not yet at work, would have been some time ago but for the interruption of all ordinary industrial occupations which has been occasioned in those countries by the war. In view of the extent to which this process thus has been and is being adopted, and of the probable completeness of the revolution which it is effecting in the mode of manufacturing an important commodity which is very largely produced in the district in which we are now assembled, Dr. Roscoe has suggested that I should this year submit to the Section a brief account of the practical results which the process has been found to yield under the more extended experience which we have now had of it, and of the development which it has undergone since the date of my paper of last year.

The process is performed by means of an apparatus of which I exhibit a model. The vessels comprised in this apparatus are arranged at five successive elevations, so that after having been pumped up to the highest of them the liquor operated upon can afterwards descend to all the others by its own gravity. The lowest of these vessels is a well, which is furnished with a mechanical agitator. The slightly acid chloride of manganese liquor with which the process commences runs from the stills in which it is produced into this well, and is there treated with finely-divided carbonate of lime, the action of which is facilitated by energetic agitation. When the neutralisation of the free acid which is at first contained in this liquor, and the decomposition of the sesquichloride of iron and sesquichloride of aluminium which are also at first contained in it, are completed, the liquor is pumped up into settling tanks placed nearly at the top of the apparatus, and known as the "chloride of manganese settlers." It now consists of a quite neutral mixed solution of chloride of manganese and chloride of calcium, containing in suspension considerable quantities of sulphate of lime and small quantities of oxide of iron and alumina. These solid matters rapidly deposit in the chloride of manganese settlers, leaving the bulk of the liquor perfectly bright and clear, and of a faint rose colour. The next step is to run off the clear portion of the contents of the chloride of manganese settlers into a vessel placed immediately below those settlers, and called the "oxidiser." This is usually a cylindrical iron vessel about 12 feet in diameter and about

22 feet deep. Two pipes go down nearly to the bottom of the oxidiser—a large one for conveying a blast of air from a blowing-engine, and a smaller one for the injection of steam. The latter is for the purpose of raising the temperature of the contents of the oxidiser when necessary—for sometimes the chloride of manganese liquor reaches the oxidiser sufficiently hot—to somewhere between 130° and 160° or 170° F. Immediately above the oxidiser is a reservoir containing milk of lime. The oxidiser having received a charge of clear liquor from the chloride of manganese settlers, and this liquor having been heated up to the proper point, if it was not already hot enough, blowing is begun, and milk of lime is then run into the oxidiser as rapidly as possible, until the filtrate from a sample taken at a tap placed nearly at the bottom of the oxidiser ceases to give a manganese reaction with solution of bleaching-powder. A certain further quantity of milk of lime is then added, and the blowing is then continued until peroxidation ceases to advance. That point is usually attained when from about 80 to 85 per cent of the manganese present has become converted into peroxide. The contents of the oxidiser are now a thin black mud, consisting of solution of chloride of calcium containing in suspension about two pounds of peroxide of manganese per cubic foot, these two pounds of peroxide of manganese being combined with varying quantities of protoxide of manganese and lime. This thin mud is now run off from the oxidiser into one or other of a range of settling-tanks ("mud settlers") placed below it, and is there left at rest until it has settled as far as it will, usually until about one-half of its volume has become clear. The clear part, consisting simply of solution of chloride of calcium, is then decanted, and the remainder, containing about four pounds of peroxide of manganese per cubic foot, is then ready to be used in the stills. There it reacts upon hydrochloric acid, liberating chlorine, with reproduction of exactly such a residual solution as was commenced with. With that solution the round of operations is begun again; and so on, time after time, indefinitely.

The quantity of lime which has to be put into the oxidiser before the filtrate from a sample of its contents ceases to give a manganese reaction, varies very considerably. Recently precipitated protoxide of manganese dissolves very appreciably in neutral solution of chloride of calcium, its solution therein comporting itself with reagents, exactly like solutions of manganese salts. It dissolves also in solution of oxychloride of calcium, that is to say, in solution of chloride of calcium containing dissolved lime; its solution in oxychloride of calcium *not* giving the ordinary manganese reactions. Hence, even if all portions of the lime added to the chloride of manganese in the oxidiser were capable of acting on chloride of manganese equally readily, manganese could not cease to be so in solution as to be detectible by ordinary reagents until more than an equivalent of lime had been added,—until enough had been added, that is to say, not only to decompose all the chloride of manganese, but also to form a certain quantity of oxychloride of calcium. It is never the case, however, that all portions of the lime used are capable of acting on the chloride of manganese with equal readiness. The lime used always contains a larger or smaller proportion of particles coarser than the rest, which coarser portions cannot of course act so rapidly as the finer portions; and as the decomposition of the chloride of manganese requires to be completed as quickly as possible, those portions of the lime which will not act upon it instantly are scarcely allowed time to act upon it at all. These coarser portions of the lime thus contribute very little to the decomposition of the chloride of manganese, though they afterwards dissolve completely in the hot solution of chloride of calcium, and then play their full part in the reactions which take place during the subsequent blowing. The proportion of the lime which thus does not act on the chloride of manganese varies with the source of the lime, and with the manner in which it is prepared; so that the quantity of lime which has to be added

\* Read before the British Association, Liverpool Meeting, Section B.



to a charge of chloride of manganese liquor in the oxidiser before the filtrate from a sample of the resulting mixture ceases to become coloured on addition of solution of bleaching-powder, varies from about 1.15 to 1.45 equivalents. The further quantity of lime which is added after that point has been reached is now usually simple enough to raise the total quantity to about 1.5 or 1.6 equivalents, being from one-half to six-tenths in excess of the quantity which actually takes part in the decomposition of the chloride of manganese.

The results which we have latterly begun to obtain with these proportions of lime are such as our previous experience had not prepared us to expect. Until quite recently, our experience seemed to show that whatever proportions of lime we might use in the oxidiser, we could not obtain products containing less than an equivalent of base or bases per equivalent of peroxide of manganese in them. Now, however, we are regularly obtaining products containing only between 0.9 and 0.7 equivalents of base, and we have occasionally got down nearly to 0.5 equivalents of base. With respect to the conditions which determine the formation of products containing these low proportions of base, all that I can say at present is that we have begun to make these products, or at any rate to make them regularly, only since we began to considerably increase the quantity of air blown in a given time into an oxidiser of a given size. There can be scarcely any doubt now that products containing at any rate something less than an equivalent of base have been made occasionally, under special circumstance, from the very beginning; but for a long time it was only so very rarely that we seemed to get less than an equivalent of base, and the apparent proportion less than an equivalent was always so small, that we put down the apparent result—a little hastily, as it now appears—to errors of analysis. It is certain, however, that products containing appreciably less than an equivalent of base have begun to be made regularly only since manufacturers who had previously employed only one blowing-engine for the process began to use two engines, blowing with both into the same oxidiser, and since other manufacturers began to work with larger blowing-engines than had been used in the process before.

All that I can learn with respect to the composition of the new products containing less than an equivalent of base tends to show, to my mind, that there are manganites corresponding to nearly all the known carbonates. We knew last year of normal manganites, corresponding, say, to normal carbonate of calcium, and of basic manganites, corresponding to Schindler's carbonate of zinc and to Bonsdorf's carbonate of lead. I venture to believe now that there are also acid manganites, corresponding to the bicarbonates, and that sesquimanganites probably exist as well.

That hydrated peroxide of manganese, or  $\text{H}_2\text{MnO}_3$ , is as distinctly an acid as  $\text{H}_2\text{CO}_3$ , or  $\text{H}_2\text{SO}_3$ , seems to me to be shown by the fact that if free hydrated peroxide of manganese be boiled with an equivalent of protoxide of manganese, a reaction takes place between the two bodies, the product of which reaction does not absorb oxygen on treatment with air. Of course, if any free  $\text{MnO}$  remained after boiling the two bodies together, oxygen would be absorbed on subsequent treatment with air. The product is, in fact, precisely the same compound—ordinarily called "sesquioxide of manganese," and written  $\text{Mn}_2\text{O}_3$ —as that which is produced by blowing air into a mixture of protoxide of manganese and water, or in any other way exposing protoxide of manganese, by itself, to the action of the atmosphere at ordinary temperatures; and its formation in the way just stated seems to me to be exactly similar to that, say, of carbonate or of sulphite of calcium by the reaction of  $\text{H}_2\text{CO}_3$  or of  $\text{H}_2\text{SO}_3$  upon  $\text{CaO}$ . Apart from its being thus formed by a reaction exactly resembling the ordinary reaction of an acid upon a basic protoxide, that which is ordinarily called sesquioxide of manganese is really manganite of hydrogen in which  $\text{H}_2$  has been

replaced by  $\text{Mn}$ , and that it is thus properly manganite or manganese, or  $\text{MnMnO}_3$ , seems to me to follow from the circumstance that, by whatever method this body may have been produced, on treating it with solution of certain salts of other metals ordinary double decompositions occur. Thus,  $\text{MnMnO}_3 + \text{CuSO}_4$  give  $\text{MnSO}_4 + \text{CuMnO}_3$ , and  $\text{MnMnO}_3 + \text{FeSO}_4$  give  $\text{MnSO}_4 + \text{FeMnO}_3$ . (This latter is a very unstable body, which soon undergoes spontaneous change; but that it is formed and exists for some time I believe to be certain). Moreover, compounds in which the basic  $\text{Mn}$  of  $\text{MnMnO}_3$  is replaced by other metals can be formed, not only by the reaction of  $\text{MnMnO}_3$  itself upon the salts of other metals, but also by the direct reaction of nascent manganous acid upon protoxides of other metals. For example, as I stated last year, whereas if protoxide of manganese by itself be treated with air in the wet way, only one-half of it undergoes peroxidation, the other half being apparently required to furnish base to the half which becomes peroxidised, if a mixture of protoxide of manganese and an equivalent of lime be treated with air in the wet way, the whole of the protoxide undergoes peroxidation, and the lime ceases to be capable of either reacting on chloride of manganese, or of dissolving in solution of chloride of calcium. Similarly, if protoxide of manganese, suspended in solution of either baryta, strontia, soda, or potash, be treated with air, baryta, strontia, soda, or potash go out of solution, and there is formed an insoluble compound containing one equivalent of manganese, three equivalents of oxygen, and one equivalent of barium, strontium, sodium, or potassium, as the case may be.

With the existence and modes of formation of normal manganites of all these metals we were acquainted last year; what is new is the apparent formation, under the conditions of working on the large scale at which we have arrived recently, of acid manganites, or double manganites of metal and hydrogen. By far the greater number of batches containing less than an equivalent of base which have been made as yet resemble in constitution one or the other of the two representative batches, the composition of which is stated on one of the diagrams I exhibit. In one of the batches, of the total manganese operated upon 86.5 per cent had been peroxidised, and for each equivalent of peroxidised manganese present there were 0.85 equivalents of bases. Regarding the constituents of the batch, for convenience, as  $\text{MnO}_2$ ,  $\text{MnO}$ , and  $\text{CaO}$ , and considering the total manganese present as a thousand equivalents, there were thus in this batch 865 equivalents of  $\text{MnO}_2$ , 135 equivalents of  $\text{MnO}$ , and 0.85 times 865, or 735 equivalent of total bases, 135 of which were  $\text{MnO}$ , the remaining 600 being  $\text{CaO}$ . Assuming that the 600  $\text{CaO}$  were combined with 600  $\text{MnO}_2$ , as normal manganite of calcium, there remained 265 equivalents  $\text{MnO}_2$  and 135 equivalents of  $\text{MnO}$ , the proportion of the former to that of the latter being very nearly two to one. These figures I hold to show the existence in this batch of an acid manganite,  $\text{MnH}_2(\text{MnO}_3)_2$ , or a compound containing the elements of one of normal manganite of manganese and one of manganite of hydrogen. In the other batch, of the total manganese present 81.5 per cent had been peroxidised, and for each equivalent of peroxide present there were 0.885 equivalents of bases. This batch, therefore, contained 815 equivalents of  $\text{MnO}_2$ , 185 equivalents of  $\text{MnO}$ , and 536 equivalents of  $\text{CaO}$ . Assuming, as before, that all the lime existed as  $\text{CaMnO}_3$ , there were left 279  $\text{MnO}_2$  and 185  $\text{MnO}$ . This is almost exactly three of the former to two of the latter, suggesting the existence in that batch of a sesquimanganite of manganese, containing the elements of two of normal manganite of manganese with those of one of manganite of hydrogen. In these batches, it is only acid manganites of manganese that I suppose to have existed; but one or two batches have been made, containing not much more than 0.5 equivalents of base, in which I believe that there must also have been an acid manganite of calcium. It may be, of course, that in all batches containing less than an equivalent of base a



portion of the manganous acid exists in the free state; but I have not yet met with any instance of a batch, the blowing of which I have known to have been continued until peroxidation had really ceased, and the proportion of base in which, while less than an equivalent, was such that the batch could not have consisted entirely of acid manganites, in which the peroxide remaining after deduction of the quantity equivalent to the combined lime contained in the batch was in any other proportion to the basic manganese contained in the batch than either that of two equivalents to one or that of three equivalents to two—a fact almost irresistibly suggestive of the two bodies being combined. The circumstance, moreover, that under no known conditions can peroxide of manganese be formed, by treating protoxide with air in the wet way, without some portion either of manganese itself or of some other metal going simultaneously into combination as base, strongly indicates that only salts of manganous acid can be formed in that way.

The quantity of air which requires to be blown into the oxidiser per given quantity of peroxide of manganese made varies with a considerable number of conditions, but more especially with the depth of the charge operated upon, and with the quantity of manganese contained in a given volume of it. Within all practicable limits, increase of the depth of the column blown into is equivalent to increase of the quantity of air blown; and the more particles of protoxide are contained in a given volume of the charge, the larger is the total surface which they present for the air to act upon, and the greater is the proportion of the total oxygen injected which becomes absorbed. The proportion of the oxygen absorbed to the quantity blown in being of course greatest at the commencement of the operation and afterwards continually diminishing, a time at length arriving, if the blowing be continued long enough, at which no more oxygen is absorbed at all, the proportion of the total quantity of oxygen absorbed to the total quantity blown in is also considerably influenced by how nearly to that point the operation be continued. The table accompanying shows the progress of the oxidation of three batches, made at different works, and constituting fair average examples of what takes place under the different conditions under which these three batches were respectively made. The quantities of air given are not absolutely accurate, but are very near approximations to the actual quantities. One of these three batches contained 1987 pounds of peroxide, reckoned as  $\text{MnO}_2$ , which was made in four hours, by the injection of about 240,000 cubic feet of air, being at the rate of about 120 cubic feet of air for every pound of  $\text{MnO}_2$  made.

This batch absorbed in the first hour 12.8 per cent of the oxygen injected, in the second hour 10.5 per cent, in the third hour 8.9 per cent, and in the fourth hour 2.0 per cent; the proportion of the total quantity absorbed to the total quantity injected being 8.5 per cent. The weight of the total oxygen absorbed was 364 pounds, of which 136 pounds were absorbed in the first hour, 111 in the second hour, 95 in the third hour, and 22 in the fourth hour. In the case of the batch next represented, a deeper column was blown into, and the blowing was stopped before the peroxidation had quite ceased. This batch contained 2500 pounds of  $\text{MnO}_2$ , made in five hours, during which about 175,000 cubic feet of air were blown in, so that in this batch only 70 cubic feet of air were used per pound of  $\text{MnO}_2$  made. The proportion of oxygen absorbed in the first hour was 20.2 per cent of the quantity blown in, in the second hour 17.5 per cent, in the third hour 16.3 per cent, in the fourth hour 13.6 per cent, and in the fifth hour 6.1 per cent; the proportion of the total quantity absorbed to the total quantity blown in being 14.8 per cent. The total quantity of oxygen absorbed was 458 pounds, of which 125 were absorbed in the first hour, 108 in the second, 101 in the third, 84 in the fourth, and 40 in the fifth. In the third batch, the column was also a deep one, and the chloride of manganese

liquor commenced with was unusually strong. On the other hand, however, the blowing was continued until the peroxidation was quite completed. This batch was blown eight hours, during which 432,000 cubic feet of air were injected, and 5400 pounds of  $\text{MnO}_2$  made, being one pound of  $\text{MnO}_2$  per 80 cubic feet of air, and the total oxygen absorbed being 13.3 per cent of the total quantity injected.

The mechanical power expended in the injection of the air into the oxidiser has hitherto averaged between seven and eight horse-power for one hour per 100 pounds of  $\text{MnO}_2$  made. I believe that it is capable of being considerably diminished, but that is about what it has usually been hitherto. The quantity of chlorine contained in a ton of bleaching-powder at 37 per cent is liberated by 1020 pounds of  $\text{MnO}_2$ , but, owing to the various losses of chlorine which occur in the manufacture of bleaching-powder, the quantity of manganite mud actually used per ton of bleaching-powder made by means of it is ordinarily the quantity containing about 1100 pounds of  $\text{MnO}_2$ , the production of which may be said to require the expenditure of about thirty-five to forty horse-power for two hours.

The lime used in the oxidiser has hitherto been usually prepared in the same manner as the lime used in bleaching-powder chambers; that is to say, it has been slaked with as nearly as may be only an equivalent of water, and the resulting hydrate then separated into two portions by means of very fine sieves, only the portion which passes through the sieves being used. Including the portion which is sieved out, and which, although it does not go into the oxidiser, is usually charged to the process, the consumption of lime in the process, per ton of bleaching-powder made by means of it, at present averages about 14 cwts. At one work on the Tyne, however, it has been reduced to 12 cwts.; and if we get to make regularly, as I believe we shall, products containing not much more than half an equivalent of base, it will eventually be reduced everywhere to below 10 cwts.

The quantity of acid consumed per ton of bleaching-powder made by means of manganite mud varies with the degree of care with which the process is performed and with the general skill of the manufacturer, being in some cases very considerably below the average quantity consumed in making a ton of bleaching-powder by means of native manganese, while in other cases it is scarcely at all below that quantity. I believe that a ton of bleaching-powder is never made in this country, by means of native manganese, from less than the acid from 60 cwts. of salt, and only rarely from less than the acid from between 70 and 80 cwts. of salt. At least one manufacturer, however, whose mud contains, as yet, by no means a minimum of base, and who at present follows a method of treating the mud in the stills, which is not quite the most economical of acid, is consuming, per ton of bleaching-powder made by means of manganite mud, only 170 cubic feet of acid at 24° Twaddell—a quantity which I believe to be producible, in practice, from less than 48 cwts. of salt. As what one manufacturer is doing can surely be done by all, when equally familiar with the process, I venture to believe that a very considerable economy of acid will eventually be realised by the process everywhere.

The loss of manganese which occurs in the process at present varies from about 4 per cent to about 10 per cent. The only unavoidable source of loss is that constituted by the deposit of sulphate of lime and other matters which forms in chloride of manganese settlers. These deposited matters have to be removed in the state of thin mud, largely mixed, that is to say, with solution of chloride of manganese. Unless this mud be well washed after its removal from the chloride of manganese settlers, and the washings be returned to the process, the manganese lost with this mud amounts to fully 5 per cent, or even more; but by suitable washing the manganese thrown away with the mud from chloride of manganese settlers can be reduced to below 2 per cent. The only other sources of



loss are, leakage of vessels, and the running away of mud by careless workmen with the chloride of calcium solution from the mud-settlers. The former of these sources of loss ought, practically, never to exist, and the latter is now being eliminated at several works by the chloride of calcium solution, instead of being run away directly from the mud-settler, being run first into catch-pools, in which any mud which may be run off with it from the mud-settlers is allowed to deposit.

Beyond the sulphate of lime and other bodies which are deposited in the chloride of manganese settlers, the only residual product of the process, and the only other thing which has to be thrown away, is solution of chloride of calcium. As this solution represents all the lime and all the limestone used in the process, and two-thirds of the chlorine contained in the acid employed, and as an industrial process is, of course, imperfect in proportion as anything whatever which is manipulated in it has to be simply thrown away, and especially in proportion as its yield of the commodity, the production of which is its sole object, falls below the total quantity contained in the materials used, I have tried to use, in the oxidiser, magnesia instead of lime, afterwards decomposing, by heat, the resulting chloride of magnesium into magnesia, for use over again, and hydrochloric acid. In that form, the process is capable of yielding, undiluted with other gases, all the chlorine contained in the acid employed, and, apart from mechanical loss, employs no materials which are not used over and over again, excepting coal and air. This form of the process has already stood the test of a certain amount of experience on the large scale; and I venture to believe that, when the time shall have arrived when it will be desirable to obtain, from a given quantity of hydrochloric acid, more chlorine than can be obtained therefrom by means of peroxide of manganese recovered by means of lime, peroxide of manganese recovered by means of magnesia will prove to be the reagent by which chlorine can be most economically manufactured.

## ON THE UTILISATION OF SEWAGE,

WITH SPECIAL REFERENCE TO THE PHOSPHATE PROCESS.\*

By DAVID FORBES, F.R.S., &c.

SINCE the universal adoption, in this country, of water as a medium for carrying off the excreta in towns, the difficulties of dealing with the sewage question, so important from a sanitary point of view, have been immensely increased, as, instead of as formerly, having to do with but a comparatively small amount of the original matter, we now have this amount diluted to several hundred times its bulk or volume, with, at the same time (at least in most cases), a proportionately still greater decrease in its agricultural value, owing to the admixture of the waste products from chemical and other manufactures, which, in themselves, are not only valueless, but frequently even highly injurious to vegetation.

As all the water, except what is carried off by evaporation, both in the excreta as well as what is added in order to float them off, must ultimately, by gravitation, find its own way to the rivers and sea, or sink into the ground to pollute the wells and springs around; and, since there is no likelihood of the employment of water being discontinued, there remains no remedy but to look this difficulty boldly in the face, and attempt to overcome it by devising some method, or rather methods (for I feel confident that no one system will be found advantageous or applicable to all local circumstances), by which the sewage may be utilised, or, at least, prevented from being, as at present, not only a nuisance, but also a source of danger, to the population around.

All the systems hitherto employed for this purpose may be classed under two heads—the purely Mechanical and the Mechanico-Chemical. Under the first, the sewage (lifted, by pumping, to a higher level when necessary) is allowed to flow directly into the nearest river or sea, to destroy the fish, pollute the stream, and carry the germs of disease to everywhere to which such contaminated water can penetrate; the only improvement in later times being, that at some places, the sewage is allowed, first, to settle, and deposit the larger portion of its solid contents, or, is passed through some species of filter, which, acting merely mechanically, keeps back the suspended particles.

Although sewage-water, so filtered, may appear perfectly clear to the eye, it hardly requires chemical analysis to show that it has not, in reality, been purified to any extent; the foetid smell which it emits, or which is soon developed upon standing, indicates that much organic matter capable of entering into putrefaction still remains in solution; and, although such putrefaction may, in some degree, be counteracted or retarded by the use of disinfectants or antiseptics (like carbolic acid, &c.), still I think it is now generally acknowledged that the required putrefaction cannot be effected by any merely mechanical system whatever.

Coming now to the mechanico-chemical systems proposed for the utilisation of sewage, we must class sewage irrigation under this head, not because it involves (at least, as usually carried out) any direct chemical treatment of the sewage, but because this system is based upon a combination of purely mechanical filtration, the soil acting as a filter, with the chemical action brought into play by the growth of the vegetation, which decomposes and assimilates the organic matter and other available substances, both in the liquid, as well as in the solid matter of the sewage; and, provided the proper ratio be observed between the supply of sewage to the ground and the capabilities of the crops to assimilate its contents, the surplus water will drain from the land in a comparatively pure and innocuous condition; so that this system, which might be appropriately termed the natural system of sewage irrigation, if properly carried out, utilises at once both the entire liquid as well as solid contents of the sewage, and leaves nothing more to be desired, provided only that the local circumstances are favourable to its being carried out.

It must not, however, be supposed to be without its drawbacks, and there are also numerous localities where sewage irrigation does not appear to be either applicable or advantageous.

It must be remembered that the distribution of foetid sewage water must taint the surrounding air; and when the soil does not allow the sewage to sink quickly into its substance or, especially if stiff clay or not well drained, becomes saturated with sewage, the smell may become so offensive that the neighbourhood will not submit to it; and it is no wonder that, under such circumstances, evidence has already been brought forward to prove that (for example, at Croydon) contagious fevers are either generated or become more prevalent. It is also stated that sewage irrigation is not suited for all crops, although very advantageous for some—as, for example, Italian rye-grass; so it becomes a question, also, as to whether a sufficient sale can be obtained for such crops in the neighbourhood; and in the case of one sewage-farm last year, I am informed that this was not the case. As far as present experience goes, it indicates also that the continued use of sewage over the same land ultimately tends to produce an unhealthy condition of vegetation; and certainly it appears to have been proved that a limit is soon reached beyond which the application of more sewage may even be positively injurious.

The expense for machinery, and appliances for pumping and distributing the sewage, of many large towns, especially when the sewage cannot be all brought to one centre, must often be so great as to deter companies, or even municipalities, from adopting this system; and, in many cases,

\* Read before the British Association, Liverpool Meeting, Section B.



suitable land cannot be obtained at all, or only at such great distances as to still further augment this great outlay. Besides this, it must be borne in mind that the area of land required to assimilate the whole of the sewage of a town like London, or any of our great commercial centres, without becoming supersaturated, will be both extremely large, as well as costly; since the value of land in the immediate neighbourhood of large towns is, as a rule, not dependent upon the value of the crops it will furnish, but is of a fictitious but infinitely higher value for building sites, &c. As regards the area required for sewage cultivation, I was informed, on a recent visit to the sewage farm at Warwick, that, after a three years' trial of 100 acres, it was found that double this amount of land would be required, in order to fully utilise the entire sewage. Now, as Warwick has only 10,000 inhabitants, and is particularly favoured by being a strictly rural town, without any chemical or other manufactories, it would follow, at this rate, that it would require much more than 60,000 acres to absorb the sewage of London.

Fully admitting the advantages of sewage irrigation when applied in certain localities, I still believe that, taking all the above circumstances into due consideration, you will agree with me as to the importance of searching for some chemical process by which the sewage may be deodorised and purified at once—at least, to such an extent, that the supernatant water may be directly run off into the rivers or sea—without danger to health or animal life, and thus avoid the necessity of erecting costly works for the collection and transmission of the sewage to localities miles distant, where it is distributed to taint the surrounding atmosphere.

Many attempts have, as might have been expected, been already made in this direction. As early as 1845, works were erected in Edinburgh, to which I acted as chemical adviser in which the sewage was treated with lime, a process which, in later years, has been carried out at Leicester, Tottenham, and Blackburn, but which has proved a failure, in a sanitary point of view, because it did not effect a sufficient purification of the water; and, as a commercial speculation, because the precipitate or manure obtained was comparatively worthless, being actually of less value than the original deposit from the sewage itself.

The treatment of sewage with lime and chloride of iron, as used at Northampton, is a process which, although apparently an improvement upon the treatment by lime alone (at least, in so far as regards the purification of the affluent water), has also failed as a commercial success, for the same reasons.

It has been known from very ancient times, that alum has a remarkable decolourising and purifying influence on foul water, which appears to be due to the property which alumina and certain other compounds have of forming combinations with organic matter and producing compounds more or less insoluble in water, a property which has long been utilised in the arts of dyeing, the manufacture of pigments and sugar, the clarification of liquids, &c., and which of late years has been applied to the purification of sewage, the salts used being ordinary alum and crude sulphate of alumina. The purification of sewage-water so effected is, however, not considered by the Rivers' Pollution Commission to be sufficient; and the value of the precipitated deposit, when used as manure, is but little better than the mere deposit from the sewage itself.

The so-called A B C process, which has of late been prominently placed before the public in connection with the Leamington and Hastings sewage, is carried out by adding to the sewage an extraordinary mixture of clay, along with alum, blood, animal or vegetable charcoal—burnt clay, salt, magnesian limestone, and compounds of magnesia and manganese, the last five substances, if not necessary, being omitted.

The major part of the purifying mixture is the clay, and next in quantity the alum, all the other substances

being added in so insignificant a proportion that they can hardly be expected to influence the result in any great degree. The chemical action of the alum has been already alluded to; but the clay seems to play a mere mechanical part, by entangling the suspended matters in the sewage, and so causing them, by its weight, to sink down or transport them to the bottom of the tank more quickly. An inspection of the working of the process at Leamington made me endorse the opinion already given by the Rivers' Pollution Commission, that it altogether failed to effect any sufficient purification of the sewage-water, or to produce a manure of such commercial value as could possibly ensure its sale at a price which could pay for its carriage to any distance beyond its immediate neighbourhood.

Having now alluded to all the principal methods which have already been tried for sewage purification and utilisation for manure, I will call your attention to an entirely novel process now brought forward by Dr. Apsley Price and myself, and which we have called the phosphate process.

This process is founded on the fact that certain mineral phosphates, easily obtainable, especially those containing alumina, when in a hydrated or freshly-precipitated state, eagerly combine with the organic matter contained in the sewage, it being sufficient merely to agitate them in the most fetid sewage to deprive it of all its odour and colour, even if tinctorial substances of great intensity be present in the solution at the same time; whilst the phosphate of magnesia combines with the ammonia contained in the sewage, and precipitates it also in the state of the double phosphate of ammonia and magnesia.

The precipitate subsides rapidly, and the water drawn off is, as you see in the experiments here before us, quite transparent, colourless, and has so little perceptible taste, that you can drink it without repugnance if you can only banish the idea from your minds that it has only just been obtained from so filthy a source.

The process is, as you will see, an extremely simple one, and requires nothing beyond a reservoir for holding the sewage whilst it is submitted to the operation. The phosphates are preferably added, in the state of solution, in sulphuric or hydrochloric acid, to the sewage, and their precipitation, in the hydrated form, along with the organic matter in the sewage, and more or less of the ammonia (dependent on the strength of the sewage and amount of time allowed to stand), is instantaneously effected by the addition of a small quantity of milk of lime, just sufficient to neutralise the acid which holds them in solution, the deposit subsides rapidly, and the supernatant water may at once be run off and discharged into the river.

Before recommending this process for adoption, we must necessarily be prepared to answer two questions, as to—

(1) Whether the water discharged after this treatment is sufficiently pure to be permitted to flow into the rivers? And—

(2) Whether the valuable constituents of the sewage have been precipitated?

Before answering the first of these questions, another must be asked, which is—When can such water be regarded as sufficiently pure? and on this point opinions are much divided; some demanding a standard of purity as high, or even higher than many natural drinking waters, whilst others are content when the affluent water is colourless, clear, and devoid of offensive smell. As the old saying is, whilst the doctors differ the patient dies, so, in this case, we still find the most offensive sewage allowed to run into and pollute our streams, because the present processes, although certainly better than no treatment at all, have not as yet secured such an ideal standard of perfection as, practically, they are not even likely ever to attain.

As regards the phosphate process, we do not claim that the affluent process is by anything like as pure as the



water supplied for drinking purposes, but are content with showing that it is as transparent and colourless as ordinary river water: that it can be taken into the mouth, and even drunk, without repugnance; that fishes can live in it; and, most important of all, that it is not only free from any offensive smell, but, as in the specimen on the table before you, has remained for months, during the entire hot summer of this year, without showing any tendency to putrefy or emit any disagreeable odour. So that, for the above reasons, we believe that the affluent water from the phosphate process may be allowed to flow directly into the rivers, without injury either to the fish in them or the health of the inhabitants on their banks.

Coming now to the second question, I would premise by stating that I believe that the agricultural value of sewage has, in general, been much over-estimated. That the excreta may have originally represented a value of from eight to twenty shillings per head, as estimated by various writers, is not improbable; but it is as incorrect to regard the sewage as representing the same value as the original excreta as, for example, to assert that the water in a barrel into which a bottle of brandy worth 5s. had been poured as equal in value to the original brandy; and I imagine that the most inveterate toper would decline to drink off the barrel for the sake of utilising the brandy in it. The whole of the brandy could be recovered by distillation, but probably at a cost greater than its value; and this would also be the case with sewage if we attempt to extract the entire manurial contents.

Chemists are all agreed that no chemical combinations are known by which the whole of the sewage contents valuable for agriculture can be precipitated; and in our attempts, fully recognising this, we have only endeavoured to extract so much as will leave the affluent water in a condition sufficiently pure as to be innoxious. In regard to the ammonia, the phosphate process converts it into the most insoluble compound known, the double phosphate of magnesia and ammonia, and the extent to which it is recovered is dependent upon the length of time allowed for subsidence and the solvent action of the water, whilst, as before stated, the experiments already made with London sewage from Barking Creek shows that the purified sewage retains but a mere trace of organic matter.

A most important feature of the phosphate process, however—one in which it differs from all those already described—is the fact that the substances employed in the purification are only such as really augment greatly the agricultural value of the precipitated manure, and thus make it sufficiently valuable to bear the cost of transport to a distance.

The solid deposit from sewage, when considered as a manure, is admitted to be but of extremely little value; so that if, as in the A B C and other processes, a large amount of clay, or other equally worthless substance, is added, this small value per ton is diminished to an extent that the resulting manure becomes utterly worthless, except in the immediate vicinity of the works. On the other hand, by the new process, what is added are compounds rich in phosphoric acid, in a state of combination available for immediate assimilation by the plants themselves.

The natural phosphate of alumina, which we specially recommend, is a product which at present has no commercial value, and occurs in the West Indian Islands in such enormous quantities that, on one island alone, the report of the survey estimates the deposit at no less than 9,000,000 tons. Many other natural phosphatic deposits, found both in this country and elsewhere, are also capable of furnishing an abundant supply of material well suited for carrying out this process at but a very small expense.

In conclusion, I may state that the object in bringing forward this communication is to direct attention to a process which, we believe, may prove an extremely valuable one in such localities as are found unsuitable for sewage irrigation, for some of the reasons before stated.

## ON THE SO-CALLED "ALKALINITY OF CARBONATE OF LIME."

By CHARLES R. C. TICHBORNE, F.C.S., M.R.I.A., &c.

My attention has been drawn to a paper by Mr. Skey, in which he states that carbonate of calcium, either artificially prepared, or in the form of limestone or calc-spar, possessed well-marked and rather decided alkalinity.\* I have been experimenting lately with lime and its compounds, and as that statement was so contrary to my observations, I think it well to point out wherein, in my opinion, lies Mr. Skey's error (a very natural one). Such statements frequently creep into manuals and other works on chemistry without being submitted to sufficient proof, and become accepted as facts.

It will be observed on reading Mr. Skey's communication that he simply relies on reddened litmus paper as a proof of the alkalinity. Now, if we examine the condition of red litmus paper, we see at once that the tinctural matter is simply loosely combined with the acid used to redden it, and that the carbonate of calcium acts by abstracting the acid, and thus the litmus is brought back to its normal colour—a blue with a shade of violet.

If Mr. Skey will repeat the following experiment, I think he will be persuaded of the neutrality of carbonate of calcium.

A little water was re-distilled from a few grains of bisulphite of potassium, the object being to get a perfectly neutral water, almost all distilled water being faintly alkaline. Red litmus paper was made by moistening litmus paper with very dilute acetic acid, washing, and drying. Blue litmus paper was purified by washing with pure water, by which it generally becomes a little more violet, the blue of ordinary litmus being due to a slight alkalinity; turmeric paper was also washed. The three papers, as thus prepared, were then placed into a test-tube with the above water, and a few grains of pure precipitated carbonate of calcium, which I had by me from a previous experiment, was added. The red litmus speedily became of its normal shade, from the abstraction of the acetic acid to form the acetate of calcium, but, on standing twenty-four hours, the other two papers did not show the slightest sign of alkalinity; even blue litmus, under such a circumstance, would become a most delicate test, as it becomes distinctly bluer to an experienced eye, and such was not the case.

The experiment was repeated, but in this case a rhomb of Iceland spar was coarsely crushed and used as the carbonate; exactly similar results were obtained, except that the change in the red litmus was slower and evidently took place only where the particles of spar were in actual contact. The blueing of the litmus paper proceeded in blotches; there was no change with the blue litmus or the turmeric papers.

Carbonate of calcium is quite neutral, and it is evident that reddened litmus paper is not reliable as a test in such a case as the above.

Laboratory, Apothecaries' Hall of Ireland.  
September, 1870.

## ON THE PRECIPITATION OF CÆSIUM AND RUBIDIUM SALTS WITH THE INSOLUBLE SALTS OF LIME.

By J. LAWRENCE SMITH.

HAVING seen E. Sonstadt's statement in the July number of the CHEMICAL NEWS, and having worked a great deal with the salts referred to in connection with lime, I never observed the reactions alluded to in Sonstadt's paper. If true, they would effect very materially the

\* CHEMICAL NEWS, vol. xxii., p. 85.



results of certain analyses in which I am now engaged; some special investigations were, however, made, to test the accuracy of his statements. 500 m.g. of pure carbonate of lime were dissolved in hydrochloric acid with 20 grammes of water; to this 150 m.g. of chloride of cæsium were added; the lime was now precipitated by carbonate of soda, the precipitate thrown on a filter and washed with the usual precautions adopted in all my analyses; the carbonate dried and weighed gave 499 m.g. of carbonate of lime.

The same experiment was made substituting carbonate of ammonia for the carbonate of soda, and the resulting carbonate of lime was 498 m.g.; the filtrate was evaporated to dryness and ignited gently, to drive off sal-ammoniac; the residue was 151 m.g., having used 150 m.g. of chloride cæsium. An experiment was also made using oxalate of ammonia; the resulting carbonate was with  $\frac{1}{4}$  m.g. of the carbonate of lime originally used. Still another experiment was made, identical with the first, and the resulting carbonate of lime was within  $\frac{1}{4}$  m.g. of the original quantity.

Experiments were made with lime and the rubidium salts, with similar results; so that Sonstadt must be mistaken in the precipitation of rubidium and cæsium salts, when lime is thrown down in the form of carbonate from solutions containing both lime and rubidium and cæsium salts, or I must have made my experiments under very different conditions from those made by him.

Louisville, Ky., August 11th, 1870.

[Professor Smith will find, on reference to our issue of July 22, that Mr. Sonstadt has anticipated the corrections which he (Professor Smith) makes.—*Ed. C. N.*]

## PROCEEDINGS OF SOCIETIES.

### ROYAL INSTITUTION OF GREAT BRITAIN.

*Notes of a Course of Seven Lectures on Electrical Phenomena and Theories.* By Professor TYNDALL, LL.D., F.R.S.

(Concluded from p. 115.)

#### *Influence of Time on Intensity of Discharge. The Condenser.*

315. The intensity of the secondary current—its “discharging distance,” for example—depends upon the rapidity with which the primary is interrupted.

316. I have already referred to the passage of particles between the two severed terminals of a circuit. By these particles the current may be kept up for a short time after the terminals have been disunited. A gradual dying away of the primary is the consequence.

317. But to produce the maximum secondary intensity it is necessary that the primary should be extinguished *at once*.

318. This is very effectually accomplished if the primary be broken between the poles of a strong magnet. The secondary spark may be thus made to overleap distances, vast in comparison with those possible to it when the rupture of contact occurs far away from the magnetic poles.

319. The magnet quenches immediately the stream of particles which accompany the spark. Thus, instead of being spread over a very sensible interval, the whole power of the primary is concentrated into an instant of time.

320. This concentration is announced by the loudness of the report of the primary spark. This augmentation of loudness was first observed by Page; it was explained by Rijke, who also exalted in the way here indicated the discharge of the secondary coil.

321. The injurious effect of the spark produced by the

rupture of contact in Ruhmkorff's coil is much diminished by the employment of a condenser, which is attached to the primary. It was introduced by Fizeau.

#### *Electric Discharge through Rarefied Gases and Vapours.*

322. The electricity from the prime conductor of an electrical machine passes through the air in the form of a dense and brilliant spark, which produces a very audible report.

323. When the discharges pass through rarefied air the discharging distance is augmented, and by sufficiently rarefying the air the discharge may be caused to pass *silently*. It then fills the tube through which it passes with a rosy light.

324. This rosy light has the same origin as that of the Aurora Borealis: it is due to the nitrogen of the air.

325. Every attenuated gas has its own characteristic colour when traversed by the electric discharge. When examined by a prism, the colour resolves itself into distinct bands; the nature of the gas may indeed be inferred from the analysis of its spectrum.

326. The discharge of the induction coil through attenuated media produces luminous effects similar to those produced by the electric machine.

327. The tubes containing the attenuated gases or vapours are usually called *vacuum tubes*. Through the tubes pass platinum wires which are fused into the glass, and between which the discharge passes.

328. Such tubes are produced in great perfection by Geissler, of Bonn, and are sometimes called Geissler's tubes.

329. Under certain circumstances, the luminous discharge is composed of distinct luminous strata, separated from each other by dark intervals transverse to the direction of the discharge. These strata were first observed by Grove; they were first observed independently and finely developed by Ruhmkorff.

330. The luminous strata were believed to arise from the intermittent action of the contact-breaker of the induction coil; but Gassiot produced them both with the electric machine, and with his battery of 3500 cells, where no contact-breaker is employed.

331. Every single discharge of the induction coil through a properly chosen medium resolves itself into a series of pulses, which declare themselves as a stratified discharge. Under similar circumstances the discharge from the voltaic battery also is resolved into a series of pulses which are declared by their stratifications.

#### *Action of Magnets on the Luminous Discharge.*

332. The luminous discharge is, to all intents and purposes, an electric current, and is acted on by a magnet like a wire carrying a current.

333. But the flexibility of the luminous current in rarefied gases enables the magnet to act upon it in a manner peculiarly interesting and instructive.

334. Placing, for example, a tube through which the luminous discharge is passing between the poles of an electro-magnet, by exciting the magnet the stream of light may be either deflected or wholly extinguished.

335. In the latter case, by interrupting the current passing round the magnet, or by lifting the tube out of the magnetic field, the luminous discharge is restored.

336. In certain cases, when the luminous discharge consists simply of a feeble glow, the supervention of the magnetic force draws a series of strongly illuminated strata from the positive terminal of the vacuum tube; when the magnetism is interrupted, these strata retreat again in succession, as if swallowed up by the positive pole. A number of exceedingly beautiful experiments of this character has been made by Gassiot.

337. It has been stated in Note 306 that the discharges from the induction coil proceed always in the same direction; hence in each vacuum tube we have a positive terminal or pole, and a negative terminal or pole.

338. When the light surrounding the negative terminal



is subjected to a magnet, it ranges itself exactly along the lines of magnetic force; the light at the positive terminal shows no such action. This discovery is due to Plücker.

*Magneto-electric Machines. Saxton's Machine. Siemens's Armature.*

339. Faraday's discovery of magneto-electricity was announced in 1831. In 1833 a machine was constructed by Saxton for the more copious development of magneto-electric currents.

340. In it copper-wire coils, within which were placed cores of iron, were caused to rotate before the poles of a powerful magnet.

341. On the approach of a coil to one of the poles of the magnet, a powerful current, whose direction depended on the nature of the pole, was induced in the coil. When the coil retreated from the magnetic pole, a current in the opposite direction was induced. This production of opposite currents by approach and withdrawal has been already referred to in Notes 283, 284.

342. By means of an instrument called a *commutator*, which reversed one of the induced currents at the proper moment, the opposite currents were caused to flow in the same direction.

343. The cores of soft iron and their associated coils constitute what is called an *armature*. In Saxton's armature the coils were wound *transversely* to the iron cores.

344. But, by winding his coils *longitudinally*, or parallel to the axis of the core, and placing the armature so formed between the poles of a series of horse-shoe magnets, Siemens obtained magneto-electric currents much more powerful than those of Saxton.

*Wilde's Machine.*

Things were in this state when, in 1866, Wilde made an important addition to our knowledge of magneto-electricity.

345. He conducted the current obtained by means of Siemens's armature round an electro-magnet, and found that the magnetism thus excited was far greater than that of the entire series of steel magnets employed to generate the magneto-electric current.

346. Thus, in one case, he found that, whereas the series of permanent magnets taken collectively was competent to support a weight of 40 lbs. only, the electro-magnet which they excited sustained a weight of 1088 lbs.

347. To produce this effect, however, it was necessary that the armature of the magneto-electric machine should rotate with great rapidity.

348. But Wilde went farther. Forming his electro-magnet from a large plate of iron, and placing between its long poles a correspondingly long armature, similar in shape and construction to that of the magneto-electric machine, he obtained from this second armature currents of enormously greater power than those obtainable from the first.

349. These currents could, in their turn, be sent round a second electro-magnet, formed from a larger plate of iron. Furnished with a rotating armature, this second electro-magnet produced effects previously unknown. Rods of iron a quarter of an inch in thickness were fused by the currents, and they were also found competent, when discharged between carbon terminals, to produce a light of intolerable brilliancy.

*Siemens's and Wheatstone's Machine.*

350. The next great step in magneto-electricity was made simultaneously by Dr. Werner Siemens and Sir Charles Wheatstone.

351. Expressed generally, this discovery consists in exalting, by means of its own action, to a high pitch of intensity an infinitesimal amount of magnetism.

352. Conceive an electro-magnetic core with a very small amount of residual magnetism, which is never

wholly absent when iron has been once magnetised. Let a secondary coil, with cores of soft iron, rotate before the poles of such a magnet. Exceedingly feeble induced currents will circulate in the secondary coil. Let these induced currents, instead of being carried away, be sent round the electro-magnet which produced them; its magnetism will be thereby exalted. It is then in a condition to produce still stronger currents. These also being sent round the magnet, raise its magnetism still higher, a more copious production of induced currents being the consequence. Thus, by a series of interactions between the electro-magnet and the secondary helix, each in turn exalting the other, the electro-magnet is raised from a state of almost perfect neutrality to one of intense magnetisation.

353. When the magnet has been raised to this condition, other coils than those employed to magnetise it may be caused to rotate before, or between, its poles; the currents from these coils may be carried away and made use of for magnetisation, for chemical decomposition, or for the electric light.

354. The first magneto-electric machine used to produce a light sufficiently intense for lighthouses was constructed by Mr. Holmes. In it permanent steel magnets and rotating helices were employed. Mr. Holmes has lately constructed a very powerful machine on the principle of Siemens and Wheatstone.

*Induced Currents of the Leyden Battery.*

355. If a Leyden jar, or battery, be discharged through a primary spiral, it evokes a current in a secondary spiral. With a strong charge this secondary current may be caused to deflagrate a foot of thin platinum wire.

356. If the current from the secondary spiral be led round a third spiral which faces a fourth, on discharging the battery through the primary spiral, the secondary in the third spiral acts the part of a primary, and evokes in the fourth spiral a *tertiary current*.

357. With another pair of spirals this tertiary current can be made to generate a current of the *fourth order*; this, again, with another pair of spirals, a current of the *fifth order*. All these currents can impart shocks, ignite gunpowder, or deflagrate wires.

For the investigation of the induced currents of the Leyden battery we are indebted to Professor Joseph Henry, Director of the Smithsonian Institution, and to Professor Riess, of Berlin.

## NOTICES OF BOOKS.

*Researches on Diamagnetism and Magne-Crystallic Action, including the Question of Diamagnetic Polarity.* By JOHN TYNDALL, LL.D., F.R.S., &c., Professor of Natural Philosophy in the Royal Institution of Great Britain. London: Longmans, Green, and Co., 1870.

THE work before us is a first instalment of the collected publication of the author's original memoirs on experimental physics, communicated by him to the *Philosophical Transactions* and the *Philosophical Magazine*, during the last 18 years. These researches were begun at Marburg at the close of 1849, and have been since continued at Berlin, and completed in England. In the introduction to this series of memoirs, the author relates the discovery of, and first researches on, diamagnetism, by the celebrated Faraday. The first 184 pages are devoted to eight memoirs by the author, and the remainder of the volume contains letters, essays, and reviews relating to magnetism and electricity; the work as it is gives to the reader a very complete and excellent account of all facts and theories relating to this portion of natural philosophy. It is copiously illustrated with plates and woodcuts, and is, in every sense of the word, a most interesting as well as useful publication.



## MISCELLANEOUS.

British Association for the Advancement of Science.—The following is a complete list of the papers which were brought before Section B (Chemical Science), at the Liverpool Meeting, under the presidency of Dr. Roscoe, F.R.S. They will be published, in full or in abstract, according to their importance, in the CHEMICAL NEWS. The President's Address.

Report of the Committee on the Chemical Nature of Cast-Iron.—Communicated by D. Forbes, F.R.S.

Henry Deacon, J.P.—A New Chlorine Process without Manganese (with illustrations).

Walter Weldon.—On the Weldon Process for the Manufacture of Chlorine (with illustrations).

A. E. Fletcher, F.C.S.—Air Pollution from Chemical Works.

J. Berger Spence, F.C.S.—On the Phenomena of the Crystallisation of a Double Salt.

W. H. Perkin, F.R.S.—On Artificial Alizarine (with illustrations).

W. Gossage, J.P.—On the Lancashire Alkali Trade.

T. Fairley, F.C.S.—On the Hydrogenation and Hydriodate of Cyanogen.

T. Fairley, F.C.S.—On the Distillation of Sulphuric Acid.

Dr. Hurter.—On the Time Needed for the Completion of Chemical Change.

J. H. Gladstone, F.R.S.—On Reciprocal Decomposition Viewed with Reference to Time.

A. Vernon Harcourt, F.R.S.—On a Method for the Determination of Sulphur in Coal Gas.

W. Marriott, F.C.S.—On the Estimation of Sulphur in Coal Gas.

J. Dewar, F.R.S.E.—Note on Thermal Equivalents—1. Fermentation. 2. Oxides of Chlorine.

J. Spiller, F.C.S.—On the Discrimination of Fibres in Mixed Fabrics.

Report of the Committee on the Treatment and Utilisation of Sewage.

David Forbes, F.R.S.—On the Utilisation of Sewage, with Special Reference to the Phosphate Process.

James Hargraves.—On the Separation from Iron Furnace Cinder of Phosphoric Acid for Manurial Purposes.

E. C. C. Stanford, F.C.S.—On the Retention of Nitrogen by Charcoal.

Dr. Gerland.—On the Action of Sulphurous Acid in Aqueous Solution on Phosphates and other Compounds.

A. E. Fletcher, F.C.S.—On the Purification of Sankey Brook.

R. C. Tichborne, F.C.S.—Dust as a Ferment.

E. Schunck, F.R.S.—On the Chemical Composition of Cotton.

C. Tomlinson, F.R.S.—On the Action of Low Temperatures on Supersaturated Saline Solutions.

C. Tomlinson, F.R.S.—On a Salt Invisible in its Mother Liquor.

Peter Spence, F.C.S.—On an Attempt to Determine the Boiling-Point of the Saturated Solution of Various Salts by Boiling with Steam of 100° C.

J. Birkbeck Nevins, M.D.—On a New Theory respecting the Heating of Liquids.

Professor A. W. Williamson, F.R.S.—Communication respecting a Resolution of the Committee of Section B on the Proposed Establishment of a New School of Applied Science by Government.

Professor Roscoe, F.R.S.—On Vanadium (illustrated by preparations of its compounds).

Dr. B. W. Gerland.—Note on the Occurrence of Vanadium.

J. Arthur Phillips, F.C.S.—Note on Claudet's Process for the Extraction of Silver.

W. H. Walenn, F.C.S.—On the Electrolytic Deposition of Copper and Brass.

J. Fenwick Allen, F.C.S.—On the Alloys of Copper, Tin, Zinc, and Lead with Manganese.

A. M'Gordon.—How to Prevent Lead-Poisoning in Water.

Dr. Moffat.—On Atmospheric Ozone.

E. C. C. Stanford, F.C.S.—On the Marbles of Tyree.

A. H. Church, M.A.—Experiments on the Preservation of Stone.

Rev. H. Highton.—On Artificial Stone and Certain Forms of Silica.

W. J. Cooper.—On the Use of Solutions of Soluble Chlorides for Laying Dust in Thoroughfares.

W. C. Roberts, F.C.S.—Note on the Absorption of Hydrogen by Electro-Deposited Iron.

Dr. Moffat.—On the Excretion of Phosphoric Acid in Connection with Atmospheric Conditions.

A. H. Church, M.A.—Contributions to Mineralogical Chemistry.

Place of Meeting for Next Year.—It has been decided to hold the next meeting of this Association at Edinburgh, under the presidency of Sir William Thomson, F.R.S., &c. The meeting in 1872 will be held at Brighton.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 13, 1870.

This number contains the following original papers and memoirs:—

New Methods of Water Analysis.—A. Müller.—The author of this paper proposes the concentration of water by means of partial evaporation *in vacuo*, the residue to be dialysed, and the colloidal substance to be submitted to putrefactive fermentation. The mineral residue formed by the method of concentration of the water just alluded to is also to be dialysed by the aid of the addition of some hydrochloric acid. The estimation of the various constituents of water is described as follows:—The water to be analysed is evaporated to dryness, after the addition of an excess of any alkaline carbonate; the dry residue is digested with hot water, and the solution filtered; the insoluble matters collected on the filter, consisting of the earthy substances contained in the water, and also the silica and phosphoric acid. The filtrate is first very accurately neutralised with either nitric, sulphuric, or hydrochloric acids, and evaporated to dryness, and next dried at from 115° to 120°, until no more loss by weighing is observed. The dry residue is, after having been weighed, first ignited by itself, and again after the addition of bichromate of potassa.

Homologues of Isethionic Acid.—E. Schwarz.—This lengthy memoir is divided into the following sections:—Experiments in the methyl, amyl, butyl series; sulphuric anhydride.

Rufigallic Acid.—B. Jaffé.—The author refers to the researches of Robiquet, Löwe, Malin, and others on this subject. The chief point of interest in this paper is the fact that rufigallic acid, when distilled with pulverised zinc, yields a hydrocarbon which, in every one of its reactions, exhibited properties akin to those of pure anthracene; while the author also observed that rufigallic acid is very similar, though not identical, with alizarine, in this respect, that it (rufigallic acid) dyes cotton, previously mordanted with aluminous and ferric mordants, fast, but by no means bright or brilliant colours. The formula of rufigallic acid is  $C_{14}H_8O_8$ , containing 4O more than alizarine. A great portion of this paper is devoted to a lengthy review of the constitution of rufigallic acid and its relation to anthracene; but this portion of the paper is illustrated by a series of lengthy and complex formulæ, which space forbids us to reproduce here. The preparation of alizarine from rufigallic acid by means of reducing agents is considered by the author as possible, but he has not yet succeeded in this direction.

Elementary Analysis.—L. Carius.—The author first refers to his former communications on this subject, published some years ago in other periodicals, and next explains that his process of analysis is chiefly intended for the rapid estimation of other elements than C, H, N, and O, present in organic compounds. His plan of action consists in an oxidation of the organic bodies enclosed in sealed tubes, heated to various but high temperatures, the glass tubes being enclosed in iron tubes. The oxidising agent chiefly employed is pure nitric acid; and the author states that this body can be heated by itself, without very much dissociation, to about 250°. It is clear, however, that, for the purpose herein alluded to,



the glass tubes should be strong, and their dimensions comparatively narrow, since, even with such small quantities as only 2.1 to 4.2 grms. of nitric acid, in tubes of from 45 to 50 c.c., the internal pressure may range from 22.3 to 44.6 atmospheres (each atmosphere = 15 lbs. to the square inch). The author states that, even if the temperature were raised to from 320° to 350°, no explosion took place. The paper, illustrated with a woodcut, gives a lengthy description of the mode of operation; and some instances are quoted to prove the value and ready action of this method. Charcoal disappears entirely at 250°; graphite requires from 300° to 330° for complete oxidation in two hours. The quantity of organic matter to be operated upon may be small, 1 grm. of material answering the purpose completely.

**Vapour Density of Acetic Acid.**—A. Naumann.—The author draws the undermentioned conclusions from some 70 vapour density estimations, made at varying temperatures and pressure:—(1) When the temperature remains constantly the same, the quantities of acetic acid contained in the unit of volume increase in greater ratio than does the pressure. (2) The density of the vapour of acetic acid, compared with that of air, under the same conditions of pressure and temperature, decreases with an increase of temperature, even though the quantity of vapour remains the same. Hence it follows that (3) the vapour of acetic acid, at different temperatures, cannot be composed of mutually-similar molecules; but equal quantities of acetic acid form, at lower temperatures, a smaller number of molecules. (4) Presumably, when an average distance between the molecules has been reached, the attraction of the molecules decreases.

**On Benzo-Kreatine.**—P. Griess.—This paper is chiefly a collection of lengthy and complex formulæ. Benzo-kreatine is the name given by the author to a new base, derived from amido-benzoic acid cyanide. The formula of benzo-kreatine is  $C_8H_9N_3O_2$ . Benzo-kreatine stands in the same relation to amido-benzoic acid as kreatine does to sarkosine.

**Researches on the Ether-Derivatives of Poly-Atomic Alcohols and Acids.**—L. Henry.—This very lengthy memoir is divided into the following sections:—Action of pentachloride and pentabromide of phosphorus upon some ethers; glycolic acid ether and lactic acid ether (the latter is the paralactic acid ether, as stated in a footnote); malic acid and uvic acid diethyl ether.

**Preparation of Naphtæ Acid on the Large Scale.**—V. Merz and H. Mühlhäuser.—This paper is identical with that quoted by us from No. 13 of the *Zeitschrift für Chemie von Beilstein*.

**On Curcumine.**—J. Kachler.—The author's researches on this subject were begun before those of MM. Daube and Gajewsky (see CHEMICAL NEWS, vol. xxii., p. 84) on this subject were published. As regards the contents of this paper, we learn, in the first place, that an aqueous decoction of the previously-ground root is a yellow-coloured turbid liquid, which can only be obtained free from vegetable matter insoluble in water by being passed through a silk sieve. The decoction contains, in addition to the ordinary vegetable substances, a large quantity of acid oxalate of potassa. The residue of the root, having been dried, was first treated with sulphide of carbon, yielding to it about 8 per cent of dark red coloured, fixed, fatty, very difficultly-saponifiable oil, which, when treated with sodium amalgam is decolourised so far as to become straw-yellow coloured; it consists of 79.8 per cent of carbon and 9.6 per cent of hydrogen, the remainder being oxygen. After having been treated with sulphide of carbon, and dried, the residual matter of the turmeric was exhausted with concentrated alcohol, yielding to it a dark brown-red coloured resin, which was found to be partly soluble in ether, and constituting what has been named curcumine. The author purified this resinous body, by dissolving it in dilute ammonia, precipitating that solution with chloride of calcium, collecting on a filter what was thrown down, and obtaining, by adding to the yellow-coloured filtrate, some hydrochloric acid, a yellow flocculent substance, which, after having been thoroughly well washed, was dried *in vacuo* over sulphuric acid, and constituted a chrome-yellow coloured powder, which, on elementary analysis, yielded, in 100 parts—Carbon, 69.90; hydrogen, 5.70. The author's opinion is that this body may be simply chrysophanic acid; and he tested this experimentally by distilling a small portion with pulverised zinc, obtaining thereby, as far as the tests executed upon a small quantity admitted of ascertaining it, a body identical with anthracene. Raw curcumine, as first obtained by exhaustion of the turmeric with alcohol as above mentioned, was dissolved in warm and very dilute caustic potassa; the deep red-brown coloured solution was boiled with sodium amalgam, and thus decolourised to a light yellow colouration. Access of air being sedulously avoided, the alkaline fluid was precipitated with an acid yielding a buff-coloured, flocculent, resinous precipitate, *a*; the filtrate containing a substance, *b*, which was extracted from the liquid with ether. *a* is evidently a resin readily soluble in alcohol, but difficultly in ether, benzol, and sulphide of carbon; after having been dissolved in alcohol, and precipitated again with water, and dried, it was found, on elementary analysis, to contain, in 100 parts—Carbon, 73.77; hydrogen, 7.76. On being oxidised with fusing caustic potassa, it yields protocatechusic acid. As regards *b*, it was left, after evaporation of the ether, as a syrupy body, consisting chiefly of a weak acid which combined well with bases; but the author's researches in this direction are not complete, for want of sufficient material, and are to be resumed.

**Researches on the Specific Heat of the Aqueous Solutions of Chemical Compounds.**—J. Thomsen.—This very lengthy memoir contains chiefly the following series of tabulated forms and results of experiments:—Specific heat of sulphuric, nitric, hydrochloric, and tartaric acids at 18°; molecular caloric of solutions of sulphuric, nitric, hydrochloric, and tartaric acids; specific heat of the alkalies—viz., hydrates of potassium and sodium, and hydrate of ammonium, at 18°; molecular caloric of aqueous solutions of caustic potassa, soda, and ammonium-hydrate.

**Cyan-Benzidine.**—E. Wittenstein.—Benzidine, prepared from azobenzol, was dissolved in alcohol, and into this solution cyanogen gas was passed until supersaturated with that gas. This alcoholic solution, after having been left standing for some time, deposited a red-coloured amorphous body, insoluble in water, only sparingly soluble in alcohol, ether, and benzol, but somewhat better soluble in light petroleum oil. [This is a very ill-defined expression for a solvent, since light petroleum oil, also known as ligroïne, is certainly not always of the same composition, and may, therefore, in some instances, turn out not to act as a solvent.] The elementary analysis of the cyan-benzidine led to the formula  $C_{14}H_{12}N_4 = C_{12}H_{12}N_2 \cdot 2CN$ .

**Dimorphism of Tin.**—C. Rammelsberg.—The author refers, at great length, to some experiments made with tin by Dr. Fritzsche and other savants, and next states that he concludes, as to the dimorphism of tin, as a result of researches which prove that the sp. gr. of tin obtained by electrolysis, and also that of the metal after exposure to great cold, is far less (viz., from 7.143 to 7.195) than after the metal has been molten, when its specific gravity varies from 7.29 to 7.31. Its form (viz., crystalline) after fusion is, as far as can be ascertained, regular; but, at a very low temperature, this form is entirely modified, and belongs to the irregular system.

**Naumann's Doctrine of the Caloric of Atoms, and on Horstmann's Criticism thereon.**—E. Budde.

*Bulletin de l'Académie Impériale des Sciences de St. Petersburg,*  
Vol. xv. (Nos. 1 and 2), May and June, 1870.

These numbers contain the following original papers relating to chemistry and collateral sciences:—

**Action of Light upon the Tissues of some Mono- and Di-Cotyledonous Plants.**—A. Batalin.—This lengthy essay, illustrated by several woodcuts, contains an account of experiments made with the view to ascertain the effect of the action of direct and diffused sunlight on the development of the different parenchyma plants are histologically composed of.

**Determination of the Weight of a Cubic Decimetre of Water at 4° C.**—H. Wild.—This memoir contains the results of a series of experiments made with the view to ascertain what precision is attainable in practice as regards the determination of the absolute weight of the cubic decimetre of distilled water at 4°; this value the author finds to be within 1 milligram. The paper also contains some observations, deduced from the author's researches, in reference to the labours of the International Committee for Decimal Weights and Measures, and the making of standard types of the same.

**Lignite Found near Sméla, District of Kijew, and the same Mineral occurring near Jelisawetgrad, District of Cherson (Russia).**—G. von Helmersen.—A lengthy geological paper, chiefly of local interest only.

**Complete Arrangement for Compensating for Temperature with the Weighing or Balance Barometer.**—H. Wild.—Illustrated with diagrams.

**New Researches concerning the Remains of Mammalia found in the Altaic Cavern, a Contribution to the Quaternary Fauna of the Russian Empire.**—F. Brandt.

**The Sponges of the White Sea and Arctic Ocean.**—N. M. von Maclay.

**Chondrodite Crystals from Finland.**—N. von Kokscharow.

**Crystals of Greenockite.**—N. von Kokscharow.—Two crystallographical essays.

**Deviation of Plumb-Line caused by the Attraction of the Caucasian Mountains.**—J. Stebnitzki.

*Bayerisches Industrie und Gewerbe Blatt,* June, 1870.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

**Earthen- and Crockery-Ware which is Injurious to Health.**—L. Buchner, E. Erlenmeyer, and C. Stölzel.—This lengthy paper is a report made by the authors to the Bavarian Minister of Commerce and Public Works, concerning the means by which, in the manufacture of earthen- and crockery-ware, the use of enamels containing lead as a flux may be either entirely avoided, or rendered innocuous, by the use of a very limited and small quantity of oxide of lead in combination with other substances, so as to prevent the glaze being acted upon by weak acids, such as, for instance, vinegar.

**Occurrence, Preparation, and Technical Application of Glycerine.**—C. Scheuer.—This very lengthy monograph contains all that is known relating to this subject, but does not mention any new researches made by the author, who has taken great care to produce an excellent and exhaustive compilation.

**Black Dyeing of Horn without the Application of Boiling Heat.**—C. Burnitz.—The objects made of horn, and ready for use, but not yet polished, are placed in a lye of caustic soda or potassa, and left therein until a portion of the surface has been dissolved, which may be readily detected by the somewhat fatty feeling the horn assumes when touched with the fingers. The objects are next washed in pure fresh water, and afterwards passed through Lucas's aniline black. After having been dried, the objects are washed, and, lastly, polished.

**Washing and Exhaustion of Precipitates and other Substances.**—Dr. Bolley.—The author applies, instead of hot and boiling liquids (water, alcohol, ether, benzol, sulphide of carbon, acetic acid),



the vapours of these fluids, in the following manner:—On the funnel containing the substance and filter to be washed or exhausted is placed another funnel of the same size (it is best that both funnels should have ground edges, but this is not indispensable), fixed by means of a sufficiently wide vulcanised india-rubber band. Through the neck of the upper funnel, steam, or the vapour of any of the above-named liquids, is made to pass, by connecting, with suitable tubing, the neck of the said funnel with a flask containing the fluid, which is kept boiling. The author states that, although steam, for instance, and the other vapours exert some pressure upon the filter, it rarely breaks; and his experience is, that, for washing precipitates (oxide of iron, for instance), hot steam works far more efficiently than hot water; while, for the purposes of exhausting substances, say, with alcohol, ether, &c., the vapours of these fluids act far more rapidly, effectively, and economically than the liquids at their boiling-point do by themselves.

*Les Mondes*, September 1, 1870.

**Curious Facts relating to Holtz's Electrical Machine.**—Dr. Morren.—The author, in a brief note addressed to the reverend editor of the above-mentioned periodical, states that he has obtained what he calls several electrograms (although not precisely specified, these appear to be a kind of photogram, but produced, not by the action of light, but by that of electricity). These electrograms exhibit—The manner electricity is distributed and seen on a positive, as well as negative point, also on a sphere of varying diameter; the electric movements which can exist in a hollow sphere electrified with positive and negative electricity; the manner electricity is distributed on different parts of the machine while in action, while giving off long, short, or middle-sized sparks, and also with or without condensers.

**Iron and Hydrogen.**—Dr. Klein.—The author, a pupil and collaborator of Professor Jacobi, of St. Petersburg, states, that the iron obtained by electrolysis is not, as has been often thought, the pure metal, but, on the contrary, a compound or mixture of iron and hydrogen, which, when heated to redness, gives off an enormous amount of that gas, and becomes, while greatly increasing in bulk, a silver-white, very soft, ductile, and malleable metal, which decomposes water readily below its boiling-point and oxidises most rapidly.

**Curious Circuit of Lightning at Valenciennes.**—Rev. F. Moigno.—At about 6 p.m. on the 27th of July last, lightning struck, and splintered to match-wood, the mast of a vessel lying in the canal; thence the lightning wended its way to an iron foundry, and, after traversing it for its full length, escaped along the iron stove-pipe placed in the office of the foundry; thence it proceeded up the steeple of St. Géry, entering there, through a broken glass-pane, the room inhabited by the tower watchman. In that room, it (the lightning) fell upon a galvanic battery, employed to convey, by means of electricity, the movements of the clockwork to the townhall clock, situated at several hundred metres' distance, causing such havoc and disturbance through the connecting wires that it was supposed the lightning had fallen on that building. Leaving the steeple of St. Géry, the lightning first fell on the house of an artist, and, after having broken some panes of glass therein, turned to the clock-tower of the college, melting, without any breakage, several panes of glass, and turning other panes of glass into a mass of curiously-coloured non-transparent substance; and, lastly, issuing again near the canal, slightly struck a soldier on duty there, and disappeared in the water. It is clear that, without special knowledge of the topography of the town above-named, it is not well possible to imagine this curious circuit, which, however, represents a broken line, having a basis of an arc of about 45°, and a total length of about 700 metres.

*Polytechnisches Journal von Dingler*, first number for August, 1870.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

**The Electric Clock.**—Dr. Arzberger.—With engravings.

**Gold, Platinum, and Silver, as Applicable to the Ornamentation of Porcelain, Glass, and other Substances.**—Dr. H. Schwarz.—This paper treats, at great length, on the commercial preparations of the metals alluded to, as manufactured for the purposes of being applied to china, porcelain, &c. The paper is too lengthy for any useful abstraction.

**Observations on Dr. Bischof's Paper concerning the Fire-Resisting Properties of Clays.**—Dr. Richters.

**Action of Nitric Acid upon Toluidine.**—M. Ballo.—This paper contains the results of some theoretical discussions elucidated by a lengthy series of formulæ, with the view to prove that it may be possible to obtain, by the action of nitric acid upon toluidine, a nitro-kresol; but, practically, the author found that this was not attainable.

**Testing Beer for the Presence of the Bitters of Quassia, Wormwood, and Marsh-Trefoil.**—L. Enders.—The beer to be tested is first evaporated on a water-bath to the consistency of a syrup; to this is added strong alcohol, whereby the dextrine is precipitated; the liquid is filtered, and the filtrate again evaporated, to extract consistency. This extract is again dissolved in strong alcohol, and mixed with ether, for the purpose of removing glucose. The liquid having been filtered, the ether is evaporated, and the residue taken up with weaker alcohol and precipitated with acetate of lead. (a.) The precipitate containing the lupuline and hop-resin is filtered off, washed with water, and, after having been suspended in some distilled water, is decomposed by sulphuretted hydrogen. The sulphide of lead is collected on a filter and washed with alcohol; the joint liquids are again evaporated to dryness, and the residue treated with chloroform. Water

is added to this solution, and the chloroform is driven off by evaporation, whereby hop-resin is separated. The aqueous solution, from which the hop-resin has been separated by filtration, yields, on evaporation, in case it contains lupuline (as with genuine beer it ought), a bitter-tasting acid residue, soluble in alcohol, ether, and chloroform, the weak alcoholic solution of which is precipitable by acetate of lead, not so by tannin, and not yielding, with an ammoniacal silver solution, a metallic mirror. (b.) The liquor which ran off from the lead precipitate is first treated with sulphuretted hydrogen, to remove excess of lead; the liquid, having been filtered, is gently heated, to expel excess of sulphuretted hydrogen gas. There is next added to the liquid an aqueous solution of tannic acid; the ensuing precipitate will contain (if they were present) the three other above-named bitters. This precipitate is next, while yet moist, mixed with carbonate of lead (white-lead, the original says), dried, exhausted with boiling alcohol, filtered, the filtrate evaporated to dryness, and the residue extracted with pure ether. (a.) The ethereal solution is evaporated to dryness. When the dry residue is mixed with concentrated sulphuric acid, it exhibits, on careful addition of water, a bluish violet colouration, yielding, when boiled with ammoniacal silver solution, a metallic mirror (absinthine). (β.) The substance which remains insoluble in ether, but is soluble in alcohol, and precipitable by tannin, but not by acetate of lead, is menyanthin (from *Menyanthes trifoliata*, marsh-trefoil), when it yields, on being warmed with ammoniacal silver solution, a metallic silver mirror; but, if this last reaction fails, quassine is present.

*Annales de Chimie et de Physique*, July, 1870.

This number contains the following original memoirs and papers:—

**Expansion of Gases.**—A. Cazin.—The continuation and concluding portion of this lengthy essay. This portion contains the following sections:—Description of a series of experiments; experiments with air; experiment with carbonic acid; observations on the expansion from 9 to 1 atmospheres; modifications of the apparatus, and description of the mode of experimenting; degree of correctness of the method; influence of the dimensions of the reservoirs; lowering of the temperature in the preceding experiments; experiments wherein  $p_1$  varies and  $p_2$  remains constant; conclusion.

**Composition of Skin, the Modifications it Undergoes by Tanning, and the Fermentation of Tannin in Tan-Pits.**—A. Muntz.—This paper is a somewhat enlarged reproduction of the author's memoir on this same subject, published in the *Comptes Rendus* of December 20th, 1869, and quoted in the *CHEMICAL NEWS*, vol. xx., p. 321.

**Researches on the Glyceric Combinations.**—L. Henry.—This paper treats more especially on glyceric tribromhydrine; and the author reviews the results of the labours of a great many scientific chemists on this substance, and finally concludes by stating that he has obtained a tribromhydrine,  $C_3H_5Br_3$ , a neutral liquid of an ethereal and not unpleasant odour; colourless; sp. gr. at 10°, 2.407; insoluble in water boiling at about 220°; and identical in properties with tribromide of allyl.

**Study on the Molecular Action Founded on the Theory of Capillary Action.**—C. A. Valson.—This very lengthy memoir is divided into the following chapters:—Introduction; on the curved lines known as "indicatrix lines"; method of experimenting; *résumé* of the experimental results; conclusions, and laws of modulus.

## NOTES AND QUERIES.

**Decomposition of Fulminate of Mercury.**—Can any of your readers inform me of a safe process for the decomposition of fulminate of mercury? I wish to obtain the mercury in the metallic state.—C. H.

**Assaying of Nickel.**—Can any of your readers who are, or may have been, students at the School of Mines give me an outline of the assaying of nickel and cobalt ores, also arsenical ores, as practised at the said school?—A STUDENT IN METALLURGY.

**Analysis of Old Yellow Metal.**—(Reply to "Copper").—We have referred to a number of works on chemistry, but do not find anywhere quoted what you desire. Unless the information occurs in the *Revue Maritime et Coloniale* or in the *Annales des Mines*, we believe your only chance of obtaining the analysis you wish for is to have them executed for you. The works referred to may be inspected at the Library of the Commissioners of Patents.

## TO CORRESPONDENTS.

**Guy's Hospital.**—In our paragraph respecting the successor to Dr. Taylor, we should have stated that Dr. Debus and Dr. Stevenson are appointed joint Lecturers on Chemistry.

**Nemo.**—There is no Examination. Fill up the certificate sent by post and forward it to the Secrétaire, Burlington House, Piccadilly, W.

**E. K.**—The *Revue des Cours Scientifiques de la France et de l'Etranger* is published at 17, Rue de l'Ecole de Médecine. Messrs. Bailliére could probably get it for you.

**B. W. Gibson.**—Received.

**Cook.**—An advertisement would be the best way of acquiring the information.

**Liverpool Royal Infirmary School of Medicine.**—In our Students' Number, for J. C. Brown, B.Sc., read J. C. Brown, D.Sc.



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## Challenge to the World.—The Bristol Daily

Times and Mirror, August 5th, has the following:—Messrs. J. C. Swan and Co., of 16, Queen's Square, in this city, have invented a pocket microscope, which is a marvel in all that such an instrument should be. It has great power, remarkable definition, and does not require focussing. The cheapness of the article will make it exceedingly popular when its merits are more widely known. It is called the "Bristol Microscope," and is a great credit to the inventor, as much for its extreme simplicity as its power.—The Western Daily Press says: The Bristol Microscope has a magnifying power of 20,000 times, &c., &c.—The Western Daily Telegraph says: The Bristol Microscope is the most compact and useful scientific instrument we have ever seen; it possesses extraordinary power, and is very easily managed, &c. The price of the Bristol Microscope is only 2s., or free by post, with printed directions, for 28 stamps.—Address, J. C. Swan and Co., Opticians, 16, Queen Square, Bristol.



# THE CHEMICAL NEWS.

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## ON A NEW METHOD OF OBTAINING CHLORINE.\*

By HENRY DEACON, J.P.

It is well known that when a mixture of hydrochloric acid gas and oxygen is sufficiently heated, portions of the hydrogen and oxygen combine and some chlorine is liberated, and the proportion of chlorine can be increased by passing the hot gases over hot porous substances. The quantity of chlorine, however, at the best is inconsiderable.

The method now under consideration induces these reactions at much lower temperatures, and so actively that the whole of the hydrochloric acid gas can be decomposed and its chlorine liberated, or pure nitrogen can be obtained from atmospheric air by combining all its oxygen with the hydrogen of hydrochloric acid.

It consists in the employment of some substance over which the hot mixed gases are passed, the substance remaining unchanged, yet influencing the changes in the gases.

Copper salts possess this power in a very marked degree, and of them sulphate of copper is so convenient that I have generally employed it. But all the compounds of copper hitherto tried have proved to be equally active; many, of course, become changed by oxidation, or are converted into chloride, the change is generally slow, whilst the activity is continuous.

Sulphate of copper, however, comes out of this experiment unchanged. All the corresponding compounds of lead, except one, are also active, but require a higher temperature. The exception is the sulphate of lead, which thus contrasts singularly with the corresponding copper compound. All the manganese compounds at still higher temperatures are also active, but it is doubtful if with manganese the reaction is ever complete. At the high temperature requisite with manganese it seems probable that chlorine itself reacts on the water produced to re-form hydrochloric acid and oxygen.

A large number of experiments have proved that all that is necessary is to dip pieces of common red brick into a saturated solution of sulphate of copper and dry them. With these charged pieces tubes are filled, and the heated gases (hydrochloric acid gas and oxygen) are passed through the tubes.

The temperature at which the reaction is most active is about 700°—750° F., but it is operative as low as about 400° F. If the temperature be raised to about 800° F., chloride of copper begins to volatilise. That is to say that, although no chloride of copper be originally employed, it is, under the circumstances, always formed and volatilised when the temperature reaches about 800° F.

The exact temperature is defined with some considerable reservation, as the difficulties of observation are very great. It is, however, believed to be correct within moderate limits, and, as might, perhaps, have been expected, the reaction depends quite as much, and with some probability more, upon the temperature of the mixed gases than upon the temperature of the influencing agent. In this way an indefinitely small particle of sulphate of copper, remaining itself at the end of the process unchanged and unmoved, can effect the liberation of the whole of the chlorine from an indefinitely large mass of hydrochloric acid gas.

In the first long-continued experiment one equivalent of copper gave upwards of 300 equivalents of chlorine, and was as active at the end as at the commencement.

It has been found that increasing the loading of sulphate of copper above a certain point on the pieces of brick does not increase their efficiency. To prove this, pieces of brick were carefully sorted as to size and used alone, and the minute amount of chlorine evolved from a heated mixture of the gases was noted.

Pieces of the same size were then boiled down with a given volume of a solution of sulphate of copper, dried and used in the same apparatus, under the same conditions, and the result noted. They were then charged with a second additional quantity of sulphate of copper, and the experiment repeated, and finally crystals of sulphate of copper itself, of the same size as the pieces of brick, were dried and used, and the result in grains of chlorine in the same time was the same in each of the experiments with copper.

In the experiments with the brick only, the quantity obtainable in the laboratory has not exceeded three per cent, whilst with copper, as before described, the whole of the chlorine has been set free. Further experiments have also shown that, at the same temperature, the same surface of copper compounds (and it is believed all other compounds follow the rule) gives the same quantity of chlorine in the same time, provided, of course, that sufficient heated oxygen and hydrochloric acid gas are presented to it. The truth of this law with copper compounds has been proved within very wide limits. The speed of the current of gases and the composition of the mixture of gases have been widely varied. The speed can be reduced until the chlorine evolved is the whole the hydrochloric acid gas contains, or increased till the chlorine evolved forms but a small percentage of the mass passing, yet the total weight of chlorine evolved from the same apparatus at the same temperature in the same time is constant. Of course if the gases were mixed with others exerting a chemical influence, the results would be varied, but with such gases as vapour of water, nitrogen, carbonic acid, and sulphuric acid gases, there is no change in the law. In point of fact, the atmosphere has been the source of oxygen almost always employed, therefore nitrogen has been constantly present, and vapour of water is one of the substances formed by the reaction, and must, therefore, always be present. Whilst the weight of chlorine remains constant, the percentage of work done will necessarily vary with the quantity of hydrochloric acid gas passed. If the current be so slow that the reaction is complete, then 100 per cent hydrochloric acid gas will be decomposed; but if double the quantity of acid gas be passed in the same time, only one-half of it will be decomposed, or only 50 per cent of its chlorine will be liberated, and similarly for other quantities.

For laboratory experiments we have used an ordinary glass combustion-tube. A little trough is made out of sheet-iron, a few iron borings are sprinkled at the bottom and the tube laid in them; heat is applied to the trough by a row of Bunsen's burners. The metal of the trough and the borings spreads the heat and secures a tolerably uniform temperature. The little pieces of brick employed with the tube are about the size of small peppercorns or large mustard seeds. A constant current of hydrochloric acid gas is obtained by using a lump of sal-ammoniac and strong vitriol in a bell hydrogen apparatus; the pressure of the gas evolved displaces the acid used, and prevents waste of material, and delivers the gas under pressure. The current of air has been obtained from the action of the Sprengel water-pump that does our laboratory filtering.

For ordinary experiments, the mixture of the gases can be regulated by dipping the two gas-delivery tubes into aqueous hydrochloric acid, and by counting the bubbles of gas from each tube. If the tubes are of equal diameter, and the same configuration, and immersed the same depth, a sufficiently accurate estimate can be formed of the proportions of the mixture. With a combustion-tube, not quite 2 feet long and about  $\frac{1}{4}$ -inch bore, the reaction will be so complete, that the resulting gases, collected in a

\* Read before the British Association, Liverpool Meeting, Section B.



2-ounce flask of white glass, exhibit very strongly the characteristic colour of chlorine. Of course the chlorine can be detected and estimated by the ordinary chemical reagents, when it is in far too small quantities to give an apparent colour in so small a mass. With due care, this experiment can be continued until the chlorine obtained is many hundred times equivalent to the copper employed; not a trace of copper will be volatilised, and, when the patience is exhausted or examination is desired, the sulphate of copper will be found intact and free from chloride of copper, fit, apparently, to continue active for an indefinitely long time. If, however, the experiment be watched through the tube from the commencement, and a piece of iodised starched paper be used to detect the first passage of chlorine in the washed gases, a change of colour will be detected in the heated sulphate of copper, simultaneously with the detection of the first chlorine. This tinge resembles the colour of heated chloride of copper, and remains constant during the experiment, but disappears as the tube cools. The known property of heated sulphate of copper to absorb hydrochloric acid gas appears, therefore, to be closely connected with this phenomenon. For more accurate experiments glass gasometers, containing the mixed gases in known proportions, and working with vitriol saturated with hydrochloric acid gas, were employed, and the current and time were, by these means, carefully regulated. The temperature, in the small scale, was ascertained, within certain limits, by the melting of enclosed morsels of metals and alloys of known composition.

I trust now to be excused for giving the reasons which led me to anticipate this reaction; for it is not a so-called accidental discovery, but, as regards chloride of copper and chloride of manganese, it was deduced from what I think a logical argument on known facts. I hope, also, to be excused in saying that, in making and applying this deduction, I was not aware that the idea of a general law of chemical action, under which this reaction appears to fall, had been originated by Mercer in 1842, before the meeting of the British Association in Manchester, and further elaborated by Playfair, in a paper read before the Chemical Society, and published in their *Transactions*, vol. iii. (1847); and, so far as I know, the subject, as regards a general law of action, still remains much as Playfair left it.

It is scarcely necessary to say the effect of any general law would be to remove a variety of chemical actions from the indefinite limbo of "contact action" or "catalysis."

Before going further, I will use Playfair's words to describe his own views and those of Berzelius, Liebig, and Mercer.

As typical of the class of reactions, Mercer's experiment may be taken. On dissolving 1 oz. of oxalic acid in  $\frac{1}{2}$  a pint of water, at 180° F., and adding to this 1 oz. of colourless nitric acid of 1.30 sp. gr., no action ensues, but immediately commences on the addition of a proto-salt of manganese, as, for example, its oxalate or nitrate. These proto-salts of manganese influence a reaction, and are themselves unacted upon. Berzelius regarded this kind of power to be "a distinct electro-chemical agency different from other recognised powers," and he named it the "catalytic force."

Liebig viewed it as a dynamical action on the atoms of a complex molecule, conceiving that the activity of the atoms of a body in a state of motion may be communicated to those of another body in a state of rest.

Mercer's view was that catalytic bodies act by exerting a feeble chemical affinity on one of the constituents of the body decomposed.

Playfair says the catalytic body is, therefore, a substance which acts by adding its own affinity to that of another body, or by exerting an attraction sufficient to effect decomposition under certain circumstances, without being powerful enough to overcome new conditions, such as elasticity and cohesion, which occasionally intervene and alter the expected result.

Playfair's paper abounds with experimental illustrations, and is most suggestive.

The idea of the law which had occurred to me proves to be an extension of the much earlier idea of Playfair's.

With your permission I will explain it from my point of view, although, after the authorities quoted, I do so with much reserve.

It appears to me that the force we call chemical action is usually dealt with as if its operations were restricted to obtaining results strictly lying within the lines of direction of the forces applied. To illustrate this mechanically, a body may be supposed to be moved from a point in the north-east to another point in the south-west. Chemically, this would be said to be accomplished either by a force acting in that direction, or first by one force, which acted from east to west, carrying the body to the west, where, subsequently upon its arrival, it was acted upon by another force from north to south, carrying it to the same point to which it would have arrived had it moved from north-east to south-west direct. And where more forces than one are concerned in the movement of the body, the forces are supposed to unite in the same direction or line, by simple addition. In mechanics, the path of motion would be held to be the resultant either of two or more forces acting in the direction of motion, or of two or more forces acting in different directions, the difference of direction being no obstacle to the effect produced as the resultant.

My idea is that concurrent chemical forces unite, and are resolved into other equivalent forces, similarly with mechanical forces. A chemical result, therefore, may either be the resultant of direct forces, or the resultant of many indirect forces acting in many directions; and, also, the resultant of indirect forces may bring about a chemical result, which lies outside the path or direction of many, and, in some cases, perhaps, outside the path of all, the forces engaged. That is to say, we may deal with the composition and decomposition of concurrent chemical forces much in the same way that we deal with these problems in mechanics.

Two familiar chemical operations formed with me the basis of this idea, namely, the manufacture of sulphuric ether by the continuous process, and the manufacture of sulphuric acid. In the first of the two, a mass of vitriol is heated, and on it is poured a small stream of alcohol, or vapour of alcohol is passed over hot vitriol. The result is the decomposition of the alcohol into ether and water, the vitriol remaining unchanged. The ordinary explanation (I believe Liebig's) is, that this depends on the union of the acid and alcohol as sulphovinic acid, and the subsequent decomposition of this acid by heat into ether and water. But, at the temperature employed, sulphovinic acid cannot exist; how then can it be formed? Again, as to sulphuric acid making. The crystalline compounds formed by the union of some of the gases, and the chamber sickness, as it is called, are almost too familiar to dwell upon. Suffice it to say that, by a series of successive reactions, which, probably, most of us have seen beautifully illustrated on the lecture-table, it is said that sulphuric acid is formed. But, in the manufacture itself, what becomes of these compounds?

They are no sooner perceived, in however minute degree, than the manufacturer of either ether or of sulphuric acid hastens to destroy them, and if any of them ever are detected in practice the process is known to be out of order.

Sulphovinic acid is a reality—these chamber compounds are realities, but they are never seen in the successful process of manufacture. Although these compounds are unseen, the forces which would form them are there. Those forces are active too, for combination is the result of action, as motion is the result of force. A moving body and a chemical combination may each be sources of force, but there is a necessary distinction to be regarded between the exertion of force and the results which ensue when that force has been exerted. I have said these compounds



are unseen, and this word should be understood in its widest sense. No contrivance can detect their presence. What more is needed to prove their absence? The conclusion I draw is, they are not there, but the forces which would make them are there, and it is to the union or composition of those concurrent forces that the reaction is due as a direct result. That is to say, using my first mechanical illustration, the path followed by the bodies operated upon, is not that from east to west, which would first make these compounds, and then by the path from north to south in order to decompose them, and so yield at the south-west the product of materials which started from the north-east, but the path followed is direct from north-west to south-east. It is the direct and not indirect resultant of the concurrent forces engaged. Engaged, but not satisfied, for the same vitriol would react on indefinitely large masses of alcohol, and the same nitrous acid would cause the formation of indefinitely large quantities of vitriol.

Having conceived this idea of the action of chemical forces, I wished to prove it. But it seems to admit of only one form of positive proof, namely, that of time. I will continue the use of the illustration already adopted, viz., two forces acting in the same plane at right angles to each other, one north to south, the other east to west, and the object starting from the north-east and delivered in the south-west. If the path of the object as governed by the forces be first from east to west and then north to south, the time occupied in the entire journey will be the times of the two separate journeys added together. But, if it passes from the conjoint influence of the two forces diagonally, and direct from north-east to south-west, the time occupied will only be the time it would occupy to perform one of the journeys. So far I have been quite unable to adopt this proof. The first conditions are wanting. It cannot, I think, yet be said in what directions the forces lie. They may also be of different kinds, attractive and dispersive. The lines of force, although brought together by some medium, may, so to say, lay in different planes, and some may oppose and some assist. There is a further difficulty when bodies are considered to be in motion under the influence of forces of constantly varying intensity. The forces of attraction and repulsion vary probably in proportion to the square of the distances, and chemical force may follow the same law. The actual path of a body amidst a number of centres of force must, therefore, be curved, for with every change of position the relative intensity of the forces acting upon it must vary. This kind of proof seems, therefore, to be at present unattainable.

The next kind of proof—that of accounting for all known phenomena of the kind called catalytic—presupposes a knowledge of all the forces engaged in each reaction, and this knowledge I certainly do not possess. The remaining available proof was to apply the theory to known cases to foretell a hitherto unknown result.

This opportunity occurred when considering a proposition to obtain chlorine from chloride of copper by first heating it, whereby half its chlorine is set free, then oxidising it in a moist atmosphere, adding hydrochloric acid to it, and again heating it, when chlorine is again evolved, and the copper compound is left for another oxidation; and thus by constantly repeated, but distinct and consecutive, operations, the same mass of copper could be used for the production of large quantities of chlorine. The same principal material, chloride of copper, was also proposed as a source of oxygen. After it has lost half its chlorine and is oxidised, as just described, it yields oxygen on heating. Here, then, was the opportunity: hydrochloric acid and oxygen are each separately attracted and held at the same temperature, by the same body; and yet if both are previously united with the body, they are let go, but are divided into chlorine and water.

I argued that the forces concerned were acting, so to say, in the same plane; they were concurrent, and should therefore unite, and the resultant should be a direct and not

an indirect reaction; the wind and the current should carry the ship diagonally but directly, not first blow her across the stream, and then afterwards float her down it to her port. This was put to the test at my request and instigation by Dr. F. Hurter, the able head of our laboratory. The first experiment that was made in a hasty extemporised way yielded 10 equivalents of chlorine from one of copper employed. For convenience, I had suggested the use of oxide of copper, not chloride, and it was mixed with peroxide of manganese, partly to prevent fusion of the chloride of copper which we expected would form, and partly because I felt persuaded that chloride of manganese would react in the same way. This expectation was also subsequently proved to be correct, but it occurs, as was anticipated, at a much higher temperature. The conversion of these oxides into chlorides was so slow that at first we thought they were unchanged. The manganese was first acted upon and then the copper, but the oxidation of the hydrogen of the hydrochloric acid was the same first and last. A regular series of experiments were then decided upon, and all were performed by Dr. Hurter in our laboratory, and to this gentleman belongs much of the credit of the success attending the experiments hitherto made. I claim the discovery and the reasoning that led up to it, as before explained, but all subsequent progress has been the result of constant conference between Dr. Hurter, Mr. Eustace Carey, the manager of the works, and myself, and I am glad to have this opportunity of acknowledging the value of their assistance.

Although the discovery was made about three years ago, it has not yet been applied successfully as a commercial undertaking to the manufacture of bleaching-powder. The delay has arisen in great part from a long and serious illness which befell me, and partly from having previously engaged to put into operation at our works another and a very successful process, Mr. Weldon's, which was at first much nearer the bird in the hand than my own.

We are now vigorously working upon the subject on the large scale, and are more and more impressed with the value of the discovery, and believe the end of our difficulties is near at hand.

One of our first difficulties was to measure the speeds of the gases. Mr. A. E. Fletcher has shown how this can be done with the use of an anemometer of his contrivance, but we found many difficulties in its use in a rough way. His table of speeds for pressure, and other information of that kind, have, however, proved invaluable. Mainly by Dr. Hurter's assistance, a different form of anemometer was devised. An example lies on the table. It was described a few months ago before the Philosophical Society of Manchester by another gentleman as his original idea. We have no reason to doubt that the same idea has occurred to others as well as ourselves; we believe, however, our instruments were in use at a much earlier date. We can speak in high terms of its value; and perhaps some members may be glad to learn of Holtzapffel's paper scales, each ruled separately by a dividing engine. Any arbitrary division can be had, so that very good verniers and scales for home-made instruments of many kinds may be obtained at small cost.

The next obstacle was a serious one, and has only been recently overcome: it was the difficulty of measuring the temperature of the gases; it being important to know it accurately and quickly, within small limits, and the range being too high for mercury. The quenching in water of masses of copper heated in the furnace, and measuring the heat gained by the water, as proposed by Siemens, is accurate, but too tedious to be of use as a constant watchman. All the ordinary pyrometers, consisting of a tube of brass outside an iron tube or rod, with some mechanical indicator of the difference of expansion between the two metals, were proved to be defective at temperatures above 500° F. The brass tube elongates both permanently and irregularly. Being deceptive, they were worse than useless.



We have recently employed rods of brass and iron instead of tubes, making the iron carry the brass, instead of, as usual, the reverse, and, up to temperatures not over  $1000^{\circ}$  F., with complete success; a very important difficulty is therefore removed by simple means. It is not easy to say why the apparently trifling change is so effective. We think the errors in ordinary pyrometers of this class arise, in part, from a permanent change in the diameter of the brass tube, which takes place with every material change of temperature, and partly from a stretching of the tube when it is softened by heat. The rod, being solid, is more uniformly heated through its diameter, and is better able to resist change of dimension in the direction of the diameter, so does not alter by mere heating and cooling. It is relieved from strain, and therefore does not stretch; and two similar-sized rods being compared together, the errors tend to correct each other.

An apprehended difficulty proved to be groundless. Nitrogen is, of course, largely mixed with the chlorine, and, it was supposed, in making bleaching-powder, might prevent the saturation of the lime with chlorine. But good bleaching-powder is easily made, even with very moderate decomposition, and consequent large dilution of chlorine, simply by employing large surfaces of lime in series, the strong gases passing over the nearly saturated lime, and the spent gases over fresh lime.

The undecomposed hydrochloric acid is removed by water, and this aqueous acid dissolves mere traces of chlorine, so that all the chlorine produced is available for operating with.

The reaction itself is a source of heat—4 volumes of hydrochloric acid and 1 volume of oxygen yielding 2 volumes of water and 2 of chlorine; that is, 5 volumes are reduced to 4 volumes. With the atmosphere as the source of oxygen, the nitrogen brings up the volumes to about 9 volumes reduced to 8. 10,679 units of heat are given out, using Favre and Silbermann's figures of 34,462 units, resulting from the union of oxygen and hydrogen, less 23,783 units required as the combining heat of hydrogen and chlorine. The water and nitrogen present absorb this heat and reduce the apparent temperature; but this evolution of heat is a material assistance in making up for the loss of heat in the decomposing apparatus from radiation.

Taking the hydrochloric acid gas as it is evolved by the ordinary salt-cake apparatus, it is found that air is normally present in sufficient quantities to liberate all the chlorine; and, as there is a wide margin for dilution in either direction, without any material evil, another anticipated difficulty disappears.

There is no occasion to be constantly watching the mixture of gases.

It has been found that iron resists, very completely, the action of the chlorine in the decomposing apparatus. A common iron gas tube is produced which has been exposed to the heated chlorine for about a fortnight, and others have been so exposed for months without any appreciable wear; iron, therefore, is freely employed, and possesses many evident advantages.

The heat of the gas requires to be carefully regulated; with too much heat, chloride of copper is sublimed; if the heat be too low, the reaction decreases, and at length stops. We use a regulator consisting of brickwork, carefully enveloped, to prevent radiation. It acts as a reservoir to absorb and yield surplus heat; and we can easily maintain a current of gases for twenty-four hours within a variation of  $25^{\circ}$  F., and without skilled attendance.

The real difficulties, as far as we know, are three. First, the large bulk of gases; these need a large apparatus. A manufacturer making 40 tons daily of sulphate of soda would have to deal with about 1,100,000 cubic feet of these gases daily; he already deals with that bulk. It is not proposed to increase the quantity evolved in the process; the difference will be in the way of treating it. In preparing the vitriol for the manufacture of his 40 tons

of sulphate of soda, he has dealt with at least 3,400,000 cubic feet of gases in vitriol chambers.

Chemical manufacturers are therefore trained to deal with gases in magnitude, and we apprehend little difficulty on this account.

Secondly, there is the preliminary heating of the gases, and this is a question mainly of durability of apparatus; it is the only part in which at present there is much wear and tear. Brick- or tile-flues, heated exteriorly, are objectionable because of the numerous joints and leakage. It is proposed to adopt Cowper's method of heating hot-blast for iron furnaces—viz., to heat a mass of brickwork, then cut off the fire to heat another mass, and pass the gases through the heated mass; by the time that it is cooled, the second mass will be heated, when the current of gas will be reversed, and so on.

We think well of this plan, but are at present trying cast-iron pipes, and, with large surfaces, moderately heated, have every prospect of success.

The last difficulty known to us arises from the volatilisation of some iron with the hydrochloric acid, and we have not yet thoroughly examined these substances. Of course they are assumed to be, and probably are, chlorides of iron, but there are peculiarities about their appearance needing investigation. The peculiarity is mainly this: they are not deposited until they reach the copper-salts.

Until very recently, we thought it was merely a condensation in a cooler part of the apparatus; but this is not the case. The difficulty itself is, that the passages become gradually filled up, and the first part of the apparatus has to be cleaned out. We find, when the copper-salts are warm enough, the sublimate we take to be chloride of iron disappears, and is replaced by sesquioxide of iron, an obturant equally objectionable. We think it is now proved that this deposition, in the first instance, is a formation depending upon the presence of chlorine; it occurs only where free chlorine is present, and is soon deposited. The sesquioxide of iron no doubt results from the decomposition of this substance in the presence of oxygen, chlorine, and moisture, at a higher temperature. The remedy we have adopted, and are now engaged in proving, is, to have the reactive filling arranged with vertical openings over an empty space (we use agricultural drain-pipes one on another). The deposit is always pulverulent, and does not interfere with the reaction of the copper-salts. These vertical channels allow the heavy dust to descend into the space below, whence it can be withdrawn, and also afford easy access for clearing from the top.

The employment of leaden, instead of iron pans, for the decomposition of the salt, and the adoption of Cowper's plan of heating the gases, would prevent the introduction of iron to a very great extent. This combination forms part of our army of reserve, for use in case of need.

The gases are propelled by the aid of a chimney-draft, and we shall probably always prefer to draw, rather than to force them. The colour of the resulting gases gives a good indication of the success of the decomposition; and the proportion of hydrochloric acid in the air is easily ascertained, when desired, by a finger-pump, drawing known quantities at each stroke through a normal alkaline solution coloured with litmus. The greater number of strokes required before the blue colour is changed to red, the more air and less acid gas is present, and *vice versa*.

In conclusion, I would give expression to some of the concurrent forces resulting in the reading of this paper.

First, we believe this process will soon materially affect the commercial industry of chlorine, and we desire to direct the attention of our fellow manufacturers to it; and, lastly, believing this little-worked mine of composition and decomposition of chemical forces offers rich prizes to skilled investigators, I desire to revive its consideration. May it not be said the skilled chemist, like the skilled navigator, can so use the union of forces, that, by aid of the wind



itself, he sails nearly in the wind's eye? And, to carry the metaphor one stage further, may it not be hoped, perhaps anticipated, that, by the application of new combinations of forces, a chemical "steam power" will make future chemists masters at will over chemical winds and tides?

## REPORT OF THE COMMITTEE ON THE CHEMICAL NATURE OF CAST-IRON.\*

WE regret to have to report that it has not been in our power, during the past year, to make any important progress in the investigation of the chemical nature of cast-iron, which was entrusted to us.

In the appendix to the report which we submitted last year, a process was described by which pure iron could be prepared in considerable quantities, and it was intended to apply this process at once to the preparation of the material necessary for our investigations. The apparatus and arrangements required for this purpose have, however, been unavoidably in a dismantled condition during the greater part of the year, in consequence of the reconstruction of the laboratories of St. Bartholomew's Hospital. They are now again in working order, and it is hoped that the experiments will be resumed without much further delay.

Numerous experiments have been made with a view to ascertain whether the pure iron sponge, prepared by the process above referred to, can be converted, by welding, into thoroughly solid masses, without detriment to the purity of the metal. Hitherto, the results obtained, though instructive in connection with the physical properties of the pure metal, have not been of promising nature in the particular direction desired. It is contemplated, however, to continue these experiments, with the aid of facilities which, we believe, will be available for this purpose, at the Royal Arsenal, Woolwich.

For the foregoing reasons, we beg leave to suggest that the re-appointment of this committee be recommended, but we do not consider it necessary to apply for a grant of money on this occasion.

F. A. ABEL, DAVID FORBES, A. MATTHIESSEN.

September 1st, 1870.

## ON THE LANCASHIRE ALKALI TRADE.†

By W. GOSSAGE.

At the meeting of the British Association for the Advancement of Science, held in Manchester in September, 1861, I had the honour to read a paper, entitled "A History of the Soda Manufacture," before the Chemical Section of that body. I now propose to submit a brief supplement to that paper, in which I will notice the various improvements connected with the processes of manufacturing soda, as then existing, during the lapse of nine years since that period; also some details of the increase which has taken place in the extent of this important manufacture during that time.

As one of the most important facts connected with the soda manufacture, I must not omit to notice the passing of a legislative measure, entitled "The Alkali Act, 1863," rendering it imperative that all manufacturers decomposing common salt, for the production of sulphate of soda, should condense not less than 95 per cent of the hydrochloric acid gas evolved by such decomposition. In my former paper I described fully the means which I had devised and carried into successful operation in the year 1836 for effecting such condensation, and these means are now

adopted universally by the soda manufacturers, and so successfully that not only do they comply with the legislative requirements of condensing 95 per cent of the hydrochloric acid set free, but in many instances this condensation exceeds 99 per cent. It has been very fortunate for the manufacturers as well as for the public that Dr. R. Angus Smith was selected by the Government to undertake the duties of chief inspector under the Alkali Act of 1863. This gentleman, with his able staff of district inspectors, has assisted greatly in promoting the effective working of the system of condensation. The able reports submitted annually to the two houses of Parliament by Dr. Smith contain the fullest details of the working of this legislative enactment, and it may be fairly expected that when the same amount of care and attention has been applied to subduing the bad effects resulting from other noxious vapours, chemical manufactories will be relieved from the charge of occasioning injury to their vicinities.

The most important use for hydrochloric acid obtained by such condensation is the manufacture of hypochlorite of lime, or bleaching-powder, the demand for which has taken an extraordinary development since the introduction of straw, esparto grass, and some other substances than rags for the manufacture of paper.

At the date of my last paper, the chlorine required for the manufacture of bleaching-powder was obtained by the action of hydrochloric acid on native peroxide of manganese. Recently Mr. Walter Weldon, of London, after long-continued devotion of time, labour, and money, has succeeded in perfecting a process by which peroxide of manganese is obtained from the chloride of manganese, produced by the action of hydrochloric acid on peroxide of manganese. Mr. Weldon effects this object by causing the chloride of manganese to be decomposed by hydrate of lime, thus producing hydrated protoxide of manganese, which he converts into peroxide of manganese, by causing streams of atmospheric air to be forced through the fluid mixture of protoxide and water. When in this state of minute division the protoxide of manganese absorbs oxygen from the atmospheric air and becomes converted into peroxide. Mr. Weldon has found it essential for successful working, that not only a sufficient proportion of lime be used to precipitate the oxide of manganese, but that such an excess be employed as will be sufficient to form a chemical compound with the peroxide of manganese as thus is produced, which compound Mr. Weldon designates as manganite of calcium. This process has been successfully carried into practice in this district, also in that of Newcastle, and it has already been adopted by some of the largest manufacturers of bleaching-powder in both these localities.

It is well known that to obtain one equivalent of chlorine by the reaction of hydrochloric acid on peroxide of manganese, it is essential that two equivalents of hydrochloric acid should be employed, one of these yielding chlorine, the other chloride of manganese.

We have had the advantage of hearing from Mr. Deacon a full explanation of his very scientific process for the manufacture of chlorine without the use of manganese, by which process the whole of the hydrochloric acid is decomposed into chlorine. By this process each equivalent of hydrochloric acid yields an equivalent of chlorine.

Mr. James Hargreaves, of Widnes, has also devised means for producing chlorine without the use of oxide of manganese. He has a process for the separation of phosphorus from the iron slag produced in the puddling operation of the iron manufacture. In carrying out this process the iron slag is treated with hydrochloric acid, and thereby protochloride of iron in solution is obtained as a bye-product, which is evaporated to dryness, producing dry protochloride, and this, by slow application of heat with access of atmospheric air, becomes perchloride, which undergoes decomposition, yielding chlorine and peroxide of iron. This process also yields an equivalent of chlorine for each equivalent of hydrochloric acid employed.

In my former paper on the soda manufacture, I took

\* Presented to the Secretary of Section B., British Association, Liverpool.

† Read before the British Association, Liverpool Meeting, Section B.



occasion to remark that nearly all the sulphur used in this manufacture (the cost of which is about equal to two-fifths of the total cost of materials required) was re-obtained in combination with calcium, forming what is expressively designated as "alkali waste."

I noticed, also, that this presented a problem worthy the attention of my juniors for its solution. Dr. Ludwig Mond, a German chemist, has made the nearest approximation to the solution of this problem with which I am at present acquainted. Mr. Mond's process consists, in the first instance, in causing atmospheric air to be brought into intimate contact with the alkali waste, as this is left in the lixiviating vats after treatment with water. This is effected by the use of a ventilating fan, which forces air into the lower part of the vat, under a false bottom. The air percolates the mass of waste, and a portion of its oxygen becomes absorbed by the sulphide of calcium yielding soluble hyposulphite of calcium, and at the same time a portion of the sulphide of calcium becomes converted into soluble polysulphide of calcium. The oxidation is so regulated, as regards its extent, that the resulting solution, when this is obtained and treated with hydrochloric acid, should yield sulphide of hydrogen and sulphurous acid in such proportions as to mutually decompose each other, yielding free sulphur at the same time that the second equivalent of sulphur contained in the hyposulphurous acid of the hyposulphite of lime is set free. A very pure sulphur, almost absolutely free from arsenic, is obtained by this mode of working.

This process has been carried out successfully by various manufacturers, but, unfortunately, the quantity of sulphur obtained is far short of that contained in the waste, and I consider the problem I have mentioned still remains as an exercise for ingenuity and perseverance.

In my former paper on the soda manufacture, I gave some particulars of the means I had adopted for obtaining copper and silver from the burned residua of copper pyrites which had been used for yielding sulphur to manufacture sulphuric acid. This mode of working has been superseded by a process devised and carried out by Mr. Henderson. This process consists in mixing a small proportion of salt with burned pyrites, previously ground to a fine powder, and exposing this mixture to a low red heat, either in open reverberatory or closed furnaces, through which a current of atmospheric air is allowed to pass. By these means the small portion of sulphur which has escaped being consumed in the burned pyrites becomes oxidised, producing sulphate of iron, which decomposes common salt, yielding chloride of copper and sulphate of soda, which are obtained in solution on lixiviating the product with water. The copper is then precipitated from the solution by means of iron, and is obtained in the metallic state. A large quantity of oxide of iron is obtained as a residuum from the lixiviation. This is sold to the iron smelters for the production of iron. These operations are carried out very extensively by the Tharsis Metal Company, at Glasgow, Newcastle, and Widnes. There are also several other establishments engaged in the same business in the neighbourhood of Widnes—amongst others that of the Widnes Metal Company, where Mr. J. A. Phillips has carried out successfully a process invented by Mr. Santler, of London, for extracting gold, silver, and lead from the burned residua of copper pyrites.

In the year 1861, during the negotiation of the French treaty of commerce, it was estimated that the total quantity of salt decomposed in Great Britain for the production of soda was 260,000 tons per annum. Of this quantity, 125,000 tons were decomposed in what is called the Newcastle district, and 135,000 tons in the Lancashire district. According to the returns of the Alkali Manufacturers' Association, for the year 1869, the total quantity of salt decomposed for the manufacture of soda was 326,000 tons, thus showing an increase of 66,000 tons, or 25 per cent on the total. Of this quantity, the decomposition in the Newcastle district, in 1869, was 142,000 tons, which, being compared with 125,000 tons in 1861, shows

an increase of 17,000 tons, or 13·6 per cent. The decomposition in the Lancashire district is returned as 184,000 tons in 1869, against 135,000 tons in 1861, showing an increase of 49,000 tons or 36 per cent. It would thus appear that the total quantity of salt decomposed for the manufacture of soda in the Lancashire district in 1869 exceeds by 30 per cent the total quantity decomposed in the Newcastle district during the same year.

One of the most important applications of soda to other manufactures is that of the production of soap, and it may be interesting to notice the increase in the production of this article, which is so essential to cleanliness, and, therefore, to civilisation. In the year 1852, when the excise duty on soap was finally abolished, the total production of soap in Great Britain was equal to 1600 tons per week, less than one-half of which was produced in the Lancashire district. From some inquiries which I have recently made I am satisfied that the present production of soap in the Lancashire district is fully equal to the total production in 1852. We may, therefore, infer that the production of this article has doubled during the past eighteen years.

I have shown from official documents that the production of soda in the Lancashire district exceeds by 30 per cent that of the Newcastle district, and when we remember the immense number of manufactories at work in Lancashire for the production of chemical substances to be used in bleaching, dyeing, calico printing, &c., we must adopt the conclusion that Lancashire is the largest seat of chemical manufactures in this country.

Dr. Roscoe said that, by way of supplementing Mr. Gossage's remarks, he might say that, in the ten years previous to 1861, the increase in the amount of salt decomposed was 300 per cent—that is to say, in the year 1852 there were 38,600 tons, while in 1861 the quantity was 135,000.

## ON THE BEHAVIOUR OF CASTOR OIL WITH PETROLEUM AND PARAFFIN OILS.

By HARRY NAPIER DRAPER, F.C.S.

THE liquids used in these experiments were:—

Petroleum oil	0·810 sp. gr.
Paraffin oil	0·817 „ „
Petroleum spirit	0·710 „ „

Each of these dissolves, at 16° C. in all proportions, the following fatty bodies:—

Almond oil.	Theobroma oil.
Olive oil.	Palm oil.
Rape oil.	Cod-liver oil.
Linseed oil.	Lard oil.
Sesame oil.	Cocoa-nut oil.
Croton oil.	Ergot oil.

And as these taken collectively typify a very large series of fatty oils, it may reasonably be supposed that there are but few exceptions to the rule of solubility. Castor oil, however, forms a very remarkable one. This oil which is on the one hand, separated from all others by its complete solubility in alcohol of sp. gr. 0·829, is, on the other, so insoluble in the petroleum hydrocarbons, that the addition of even one-half per cent to either paraffin oil or refined petroleum at 16° C. causes turbidity. At 50° C. a large quantity is taken up, but separates immediately as the liquid cools.

But though castor oil is itself insoluble in the petroleum oils, it exercises itself a solvent action upon them, which is remarkable for being limited in a very unusual manner.

If castor oil be shaken with excess of petroleum spirit at 16° C. and allowed to rest, it will be found to form two layers, the upper of which consists of petroleum spirit alone, and the lower of a mixture of petroleum spirit and castor oil in equal volumes.



The results of several experiments have shown that—  
100 vols. of petroleum spirit dissolve 100 vols. of castor oil.  
100 „ „ oil „ 67 „ „  
100 „ paraffin oil 67 „ „

If the hydrocarbons be agitated with castor oil in any larger proportions than these, the excess separates, but the increase in volume of the castor oil is always the same, so that castor oil does not affect the separation of any particular hydrocarbon.

There is no difference in the behaviour of East-India and Italian castor oils.

This reaction cannot, unfortunately, be used as a test for the presence of castor oil in other oils, because the presence of other fatty bodies in any quantity renders castor oil soluble in the petroleum oils. It will, however, distinguish this series of hydrocarbons from benzol, in which castor oil is soluble in all proportions.

Dublin, August, 1870.

## EXAMPLES FOR PRACTICE IN QUANTITATIVE CHEMICAL ANALYSIS.\*

By FRANK H. STORER,  
Professor in Massachusetts Institute of Technology.  
(Continued from p. 109).

### EXPERIMENT IV.—Estimation of Water and Magnesia in Epsom Salt.

To prepare a sample of crystallised salt proper for analysis, heat 40 or 50 grms. of commercial Epsom salt with as much boiling water as may be needed to dissolve it, filter the boiling liquid into an evaporating dish, and leave the latter at rest until its contents have become cold. A coating of crystals will then be found adhering to the bottom and sides of the dish. Pour off the liquor from above these crystals and fasten the dish in a vertical position, in such manner that most of the mother liquor may drain away and the crystals be left nearly dry. Press the moist crystals repeatedly between folds of thick filter paper until they become so dry that they no longer stick to the paper. Then weigh out about 4 grms. of the crystals for analysis.

To determine the water in the crystals proceed as in the analysis of gypsum (*Expt. II.*; CHEMICAL NEWS, vol. xxii., p. 99).

In our experiment 3.664 grms. of freshly crystallised Epsom salt lost 1.879 grms. of water on being heated. Or, in terms of per cent, 51.28. Theory requires 51.22 per cent.

To determine the magnesia, transfer the ignited salt from the crucible to a beaker of about 700 c.c. capacity, dissolve it in some 400 c.c. of cold water, stir into the solution 40 or 50 c.c. of a tolerably strong solution of chloride of ammonium together with enough ammonia water to make the liquid slightly alkaline. Finally, add a quantity of a solution of ordinary phosphate of soda, and stir the mixture thoroughly, taking care not to touch the sides of the beaker with the stirring rod. The precipitate of phosphate of magnesium and ammonium which falls is a crystalline substance liable to adhere firmly to any scratch, or even mark, which the stirring rod might leave upon the sides of the beaker in case it were allowed to rub against the glass. The liquid must not be heated at any time, lest the formation of the crystals be hindered.

As soon as it appears that a slight excess of the phosphate of sodium has been added, cover the beaker and leave it at rest for twelve hours or more, in order that the crystals of the double phosphate may all be deposited. Then pour the liquid and precipitate upon a six-inch filter, and wash the precipitate with a mixture of three parts water and one part strong ammonia water until a few drops of the filtrate show only a slight cloudiness on

being mixed with a drop of nitric acid and a drop of nitrate of silver. Dry the precipitate, ignite it intensely in a porcelain crucible, and weigh the pyrophosphate of magnesium which remains.

There was obtained 1.672 grms. of  $2\text{MgO}, \text{P}_2\text{O}_5$  (=0.6025 grms.  $\text{MgO}$ ). This result indicates 16.44 per cent of magnesia in the Epsom salt. Theory requires 16.26 per cent.

The sulphuric acid could of course be determined by precipitating it with chloride of barium, as in *Expt. II.*, or it may be estimated by the difference, as was done in the present case. The complete analysis was as follows:—

	Found.	Theory.
$\text{MgO}$ .. .. .	16.44	16.26
$\text{SO}_3$ (by difference) .. ..	32.28	32.52
$7\text{H}_2\text{O}$ .. .. .	51.28	51.22
	100.00	100.00

(To be continued).

## ON A STEAM FILTER PUMP.\*

By Dr. J. WALZ.

THERE are many locations in which the Bunsen filter pump cannot be employed on account of a deficiency in the water supply. For such cases a plan has been devised by Dr. Walz of New York, editor of the *Manufacturers' Review and Industrial Record*, which is described in that journal, and has been proved in practice to be efficient.



The accompanying cut shows the outline section of the most important part of the apparatus. A is a tube supplied with steam from a flask or boiler; E is connected with the exhaust of the filter. By the action of the steam jet identical with that known as the "exhaust" in a locomotive, a vacuum is produced in B, C, D. By sliding the tube, A, back and forward in the cork, B, an adjustment can be given to the outlet within D, so as to secure the best effect.

The conditions of best effect here are identical with those in the inner nozzle of the Giffard injector when it is starting its water supply from a lower level, and no doubt the proportions found most efficient in that instrument will prove also in this.

## CHEMICAL TABLES ACCORDING TO THE THEORIES OF MODERN CHEMISTRY.†

By Professor ALBERT R. LEEDS.

(Continued from page 40.)

IN the *Comptes Rendus*, vol. xx., p. 1047, will be found another series of careful and laborious determinations of certain atomic weights by Pélouze. Other valuable contributions to our knowledge in this direction will be found in the *Bibliothèque Univ. de Genève*, vol. xlvi, by De Marignac, and by Erdmann and Marchand, in the *Fourn. für Prakt. Chem.*, vols. xviii., xxvi., xxxi., and xxxiii. A brief synopsis of the processes and results which are given in the above-cited memoirs, is appended to Miller's "Elements of Chemistry," Part II., p. 859. For special contributions to our knowledge of the atomic weights of antimony, cadmium, and lithium, consult *Chem. Centr.*, 1857, pp. 454 and 897; *Wien. Acad. Ber.*, vol. xxv., 118; *Fourn.*

\* Communicated by the Author.

† Communicated by Professor Morton. From advance-sheets of the *Journal of the Franklin Institute*.

\* Communicated by the Author. From the *Massachusetts Teacher*.



für Prakt. Chem., vol. lxxii., p. 338; *Ann. Chem. Phys.* [3], vol. li., p. 103; *Silliman's Amer. Journ.* [2], vol. xxviii., p. 349; *Ann. Chem. Pharm.*, vol. cxxi., p. 93; *Comptes Rendus*, vol. liv., p. 366. Abstracts and references concerning the atomic weights of cæsium, rubidium, and thallium will be found in the *Jahresber. der Chem.* In a recent number of the *Journ. für Prakt. Chem.*, 1869, Rammelsberg has re-calculated the atomic weights of tantalum and niobium (columbium) after the analyses of Rose and De Marignac. In the *Am. Journ. Sci.* [2], vol. xlv., p. 53, Dr. Genth has published the re-determination of the atomic weight of cerium, by Dr. C. Wolf, and his results are here accepted as representing at present the closest approximation to the truth. For the atomic weights of erbium and yttrium, consult the memoir, by Bahr and Bunsen, in the *Ann. Chem. Pharm.*, vol. cxxxvii., p. 1, and for terbium, that by Delafontaine, same journal, vol. cxxxiv., p. 99. Two series of independent analyses are given by Winkler, in the *Journ. für Prakt. Chem.*, vol. cii., p. 273, the mean of which makes the atomic weight of indium 37.81. To vanadium, Roscoe assigns an atomic weight of 51.33 (*Phil. Mag.* [4], vol. xxxv., p. 307).

De Marignac assigns to didymium the atomic weight 47.92 (*Ann. Chem. Phys.* [3], vol. xxxviii., p. 148; to lanthanum the concordant results of Mosander, Holzmann, and R. Hermann give 46.4 (*Journ. für Prakt. Chem.*, vol. lxxv., p. 321. and vol. lxxxii., p. 385). Our information concerning ruthenium is almost entirely derived from the labours of Claus (*Ann. Pharm.*, vol. lvi., p. 257, vol. lix., p. 234, and vol. lxiii., p. 259, which makes its atomic weight 52.1. From a careful perusal of the chemical testimony adduced in the foregoing memoirs, as to the true atomic weights, Table III. of the atomic weights, according to ancient chemistry, has been derived. Where the chemical testimony appeared equally strong for different values of the atomic weight of any element, the law of specific heats and isomorphism have afforded help in the decision. It is not expected that others would be impressed in precisely the same way by a similar examination of these data. But it is hoped that the table here given will commend itself as an accurate and impartial summary of our present knowledge, and that it may be taken with safety and advantage as a groundwork for the tables which follow. Appended to the atomic weight of each element is the authority upon which it rests. In every case, the result of the analyses themselves is given, and not the atomic weight deduced from them in accordance with Prout's law, or any other theoretical consideration. Neither has the mean of the atomic weights obtained by several observers for any element been taken, because we do not thus necessarily arrive at a truer approximation.

Upon Table III., as a foundation, Table IV. has been built up, in agreement with the hypotheses of modern chemistry. To mention what these hypotheses are, and in what manner they have been applied to the atomic weights of each element, would be vastly beyond the reach of our present purpose. They involve the labours of Kolbe, Kekulé, Hofmann, Frankland, Williamson, and a host of others who have projected and established the new chemical system.

In some cases, the atomic weights which are given as those of Berzelius, in the Table, according to ancient chemistry, are half of what he himself adopted. In regard to the atomic weights, the opinions of Berzelius, in many instances, were juster than those of the chemists who followed him—they retrograded.

TABLE I.

## Atomic Weights according to the Original Observers.

ELEMENT.	BERZELIUS.		OTHER OBSERVERS.
	O=100.	H=1.	
Aluminum .. ..	170.900	27.390	13.744, Dumas.
Antimony .. ..	806.452	129.240	120.3, Schneider; 120.69, Rose; 122.34, Dexter; 122, Dumas.
Arsenic .. ..	469.400	75.225	75, Pérouze; 74.95, Dumas.

ELEMENT.	BERZELIUS.		OTHER OBSERVERS.
	O=100.	H=1.	
Barium .. ..	855.290	137.070	68.51, Dumas; 68.64, Pérouze; 68.58, De Marignac. [1330.377, Lagerhjelm, adopted by Berzelius;] 210.34, Dumas.
Bismuth .. ..	1330.377	213.200	[136.204, boracic acid being regarded by Berzelius as Bo <sub>6</sub> ;] 11, Dumas.
Boron .. ..	136.204	21.830	[499.81, De Marignac, adopted by Berzelius.]
Bromine .. ..	499.810	80.102	[696.767, Stromeyer, adopted by Berzelius;] 56.12, Dumas; 56, C. v. Hauer.
Cadmium .. ..	696.767	111.660	133.00, Johnson and Allen.
Cæsium .. ..	—	—	20.01, Dumas; 20.03, Erdmann and Marchand; 20.105, De Marignac.
Calcium .. ..	251.651	40.329	[75.005, Dumas;] 6.007, Erdmann and Marchand; 6.06, Liebig and Redtenbacher.
Carbon .. ..	75.120	12.040	[221.64, De Marignac, adopted by Berzelius;] 35.505, Dumas; 35.476, Maumené; 35.46, Stas.
Chlorine .. ..	221.640	35.520	[328.38, Berlin, adopted by Berzelius;] 26.24, Péligot.
Chromium .. ..	328.380	52.630	[368.65, Rothoff, adopted by Berzelius;] 29.54, Dumas; 30, Schneider.
Cobalt .. ..	368.650	59.080	98.45, Rose and De Marignac, re-calculated by Rammelsberg.
Columbium .. ..	—	—	[396.6, Erdmann and Marchand.]
Copper .. ..	395.600	63.400	47.92, De Marignac.
Didymium .. ..	—	—	56.3, Bahr and Bunsen.
Erbium .. ..	—	—	19, Louyet; 19, Dumas.
Fluorine .. ..	117.717	18.865	[87.124, Awdejew, adopted by Berzelius.]
Glucinum .. ..	87.124	13.960	—
Gold .. ..	1229.165	196.990	—
Hydrogen .. ..	6.240	1.000	[12.5, Dumas; 12.5, Erdmann and Marchand.]
Indium .. ..	—	—	37.813, Winkler.
Iodine .. ..	792.996	127.080	[792.996, De Marignac, quoted by Berzelius;] 127, Dumas.
Iridium .. ..	1232.080	197.460	—
Iron .. ..	350.527	56.180	[350.59, Svanberg and Norlin; 350.1, Erdmann and Marchand;] 28.07, Dumas.
Lanthanum .. ..	—	—	46.4, Mosander, Holzman, and R. Hermann.
Lead .. ..	1294.645	207.460	103.5, Dumas; 103.456, Stas.
Lithium .. ..	81.660	13.087	6.97, Mallet.
Magnesium .. ..	158.140	24.760	12.11, Scheerer; 12.35, Svanberg and Nordenfeldt; 12.3, Dumas.
Manganese .. ..	344.684	55.240	27.48, Dumas.
Mercury .. ..	1251.290	200.530	[1251.29, Erdmann and Marchand, quoted by Berzelius; 1265.823, Sefström.]
Molybdenum .. ..	596.100	93.360	46.06, Svanberg and Struve; 48, Dumas.
Nickel .. ..	369.330	59.190	[369.33, Rothoff, adopted by Berzelius;] 29.51, Dumas; 29, Schneider.
Nitrogen .. ..	88.520	13.708	[88.52, De Marignac, adopted by Berzelius;] 14, Dumas; 14.041, Stas; 13.95, Anderson and Svanberg.
Osmium .. ..	1242.624	199.140	—
Oxygen .. ..	100.000	16.026	—
Palladium .. ..	665.477	106.650	—
Phosphorus .. ..	196.0205	31.414	32.02, Pelouze; 31.03, Dumas; 31, Schrötter.
Platinum .. ..	1232.080	197.000	98.94, Andrews.
Potassium .. ..	488.856	78.340	[488.856, De Marignac, adopted by Berzelius;] 38.95, Maumené; 39.14, Pérouze; 39.13, Stas.
Rhodium .. ..	651.962	104.480	—
Rubidium .. ..	—	—	85.4, Bunsen.
Ruthenium .. ..	—	—	52.1, Claus.
Selenium .. ..	495.285	79.374	—
Silicon .. ..	277.778	44.520	[Berzelius regarded silicic anhydride as SiO <sub>2</sub> ;] 14.24, Pérouze; 14.01, Dumas.
Silver .. ..	1349.660	216.290	107.97, Maumené; 107.945, Stas.
Sodium .. ..	289.729	46.430	22.97, Pérouze; 23.01, Dumas; 23.05, Stas.
Strontium .. ..	545.929	87.490	[545.929, Stromeyer, adopted by Berzelius;] 43.97, De Marignac; 43.84, Pérouze; 43.74, Dumas.
Sulphur .. ..	200.750	32.170	16, Dumas; 32.074, Stas.



ELEMENT.	BERZELIUS.		OTHER OBSERVERS.
	O=100.	H=1.	
Tantalum .. ..	1148.365	184.040	182, Rose and De Marignac; re-calculated by Rammelsberg.
Tellurium .. ..	801.760	128.510	64.5, Dumas.
Terbium .. ..	—	—	37.68, Delafontaine.
Thallium .. ..	—	—	203, Crookes; 204, Lamy.
Thorium .. ..	743.860	119.210	—
Tin .. ..	735.294	117.840	58.05, Mulder; 59.03, Dumas.
Titanium .. ..	301.550	48.330	[301.55, H. Rose, adopted by Berzelius;] 25.17, Pierre.
Tungsten .. ..	1188.360	190.450	92, Dumas.
Uranium .. ..	742.875	119.060	[742.875, Ebelman, adopted by Berzelius.]
Vanadium .. ..	856.892	137.330	51.33, Roscoe.
Yttrium .. ..	—	—	30.85, Bahr and Bunsen.
Zinc .. ..	406.591	63.690	[406.591, Erdmann, adopted by Berzelius; 414.0, Jacquelin; 412.5, Favre.]
Zirconium .. ..	419.728	67.260	[419.728, when, as regarded by Berzelius, zirconia is $Zr_2O_3$ .] According to De Marignac and Dumas, Zirconia is $ZrO$ . Then the atomic weight is 22.4.

(To be continued.)

## NOTICES OF BOOKS.

*Alkali Act, 1863: Sixth Annual Report, by the Inspector (Dr. R. Angus Smith, F.R.S.) of his Proceedings during the year 1869.* Presented to both Houses of Parliament by command of Her Majesty. London: 1870.

THE work before us, in common parlance a *blue book*, will, we greatly fear, not receive that due appreciation of its merits which its highly valuable contents deserve. It is not merely an official report of duties often performed simply according to a well-established routine; on the contrary, we have to deal, in the first place, with a scientific monograph on the condition of the air in various places exposed to the influence of manufactures, and also on the condition of the air where manufactures do not exist. The eminent author has attempted to give, and we may even say, judging from the pages before us, well succeeded in giving, such an account of the state of the atmosphere of any given place, that it is possible to say, without difficulty, whether it may be considered as tainted by manufactures, or whether it has a large amount of organic matter in it. Moreover, an answer has, to some extent, been given to the question as to the condition of that matter, as it is of importance to distinguish it from that caused by manufacturing processes. The modes by which the air has been studied are—(1) By the usual examination for the gases, oxygen and nitrogen; (2) carbonic acid; (3) ammonia; (4) ammonia from albumenoid matters; (5) nitric acid; (6) rapidly oxidisable matters; (7) slowly oxidisable matters; (8) chlorides and sulphates; (9) acidity; (10) examination of the rain, including an estimation of all the substances mentioned as in the air, the gases excepted.

The author's work is so full of interesting matter, and the results are so condensed, that we regret to say that the ensuing *embarras de richesse* prevents us quoting here more than a mere drop, so to say, from an ocean of valuable and highly-interesting results. The average quantity of hydrochloric acid in rain, in parts per million, varies from 0.97 at Darmstadt, to 25.74 at Runcorn; while at London it is 1.25, and in Scotland (sea-coast and inland country places) 7.95. The distance from the sea mainly governs the amount of chlorine. Total acids of chlorine and sulphur, the relation to the average of that from Row, Dumbartonshire, being taken as unit (1) we find—England (inland places),  $1\frac{3}{4}$ ; Scotland (sea-side and inland places), 2; Germany (some specimens),  $3\frac{1}{2}$ ; London,  $4\frac{1}{2}$ ; Liverpool,  $9\frac{1}{2}$ ; Runcorn, 10; Newcastle-on-Tyne,  $10\frac{1}{2}$ ; near an alkali works,  $15\frac{1}{2}$ . The acids here meant are

both the combined and the uncombined. *Air—Total Acid* (relation to Blackpool taken as 100).—London, 289; St. Helen's, 474; Manchester, 527; Underground Railway (Metropolitan), 1483. *Air—Hydrochloric Acid* (relation to Blackpool taken as 100).—Buxton, 247; London, 320; St. Helen's, 516; Underground Railway (Metropolitan), 974. *Air—Sulphuric Acid* (relation to Blackpool taken as 100).—Didsbury, 320; London, 361; Manchester, 549; Underground Railway (Metropolitan), 1554. *Air—Total Ammonia* (relation to Inellan taken as 100).—London, 117; a bedroom, 179; Glasgow, 202. These scanty instances, taken at random from the large number of tabulated results, may convey some, but, we are bound to say, a very imperfect, idea of the contents of the first and main portion of this valuable treatise. The second portion of this work is devoted to the subject of the condensation of hydrochloric acid at the alkali works.

Our readers will recollect that the Alkali Act of 1863 was made law with the view of enforcing a proper system of condensation of hydrochloric acid, and to prevent neglectful escape of gas. This end, we are glad to see, has been very well arrived at; and, as a proof of the genuine desire on the part also of the manufacturers, to attain a high efficiency of condensation, we are informed that, at two works in the Newcastle-on-Tyne district, permanent structures have been erected, at a cost of £10,000 for each alkali work. There are added to this valuable Report large lithographic plates representing the structures alluded to.

## CORRESPONDENCE.

### FILTRATION OF STRONG ACIDS.

To the Editor of the Chemical News.

SIR,—As some of your readers may, like myself, have found considerable difficulty in the filtration of the strong mineral acids, I take this opportunity of acquainting you with the mode by which I think this can best be accomplished.

Into the narrow part of an ordinary glass funnel, spun glass (such as is used in making tails for glass birds) is closely packed, and over this is sprinkled ground glass to the depth of a quarter of an inch, care being taken that both the funnel and glass are perfectly clean. About 4 ounces of boiling water are then allowed to pass through the filter, which is then allowed to dry, and, previous to being used, is moistened with a pure specimen of the acid to be filtered.

A filter so constructed is as efficient as any with which I am acquainted, is very durable and cheap, while, from the fact that these acids do not act on glass, freedom from contamination during the process is perfectly ensured.

I may mention that such filters, or the materials necessary for their preparation, may be obtained at Mr. Motherwell's, 73, Union Street, Glasgow.—I am, &c.,

JAMES ST. CLAIR GRAY, M.B., C.M.,

Assistant to the Professor of Forensic  
Medicine, Glasgow University.

## MISCELLANEOUS.

**Hydrated Chloride of Aluminium as an Antiseptic.**—We learn that a strong solution of this substance is coming into use as an antiseptic. The advantages which it possesses are that it is non-poisonous and devoid of smell, being, at the same time, a powerful antiseptic. It is to be met with in commerce under the name of "choralum."

**The Ladies' Medical College.**—The seventh annual session of study will commence with an introductory



address by J. A. R. Newlands, Esq., F.C.S. The address will be given at St. George's Hall, at three o'clock on Monday, October 10th, and the chair will be taken by Dr. Ross. The general public are invited to be present. Intending students should apply to the Lady Secretary of the Female Medical Society, at the Offices, 164, Great Portland Street, W.

**New Works on Chemistry, &c.**—The following are amongst the new works Messrs. Churchill are preparing for publication:—"A Manual of Botany," by Robert Bentley, Professor of Botany, King's College, London, and to the Pharmaceutical Society (second edition). "A Laboratory Text-Book of Practical Chemistry, or Introduction to Qualitative Analysis;" a guide to the course of practical instruction given in the laboratories of the Royal College of Chemistry, by W. G. Valentin, F.C.S. "Handbook of Volumetric Analysis, or the Quantitative Estimation of Chemical Substances by Measure," by Francis Sutton, F.C.S., Norwich (second edition, much enlarged). "The Year-Book of Pharmacy," containing the proceedings at the yearly meeting of the British Pharmaceutical Conference, and a Report on the Progress of Pharmacy, which will include notices of all Pharmaceutical papers, new processes, preparations, and formulæ published throughout the world.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

*Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

[In consequence of the war on the Continent, several of the foreign journals have failed to reach us; we shall, however, give abstracts of them as soon as they are received.]

*Comptes Rendus des Séances de l'Académie des Sciences*, September 12, 1870.

This number contains the following original papers and memoirs relating to physico-chemical and allied sciences:—

**What are the True Chemical Agents to be Used as Antiseptics?**—M. Faye.—This paper contains a lengthy review on the mode of action of several substances used as disinfectants and antiseptics, and especially as regards the action of phenol (carbolic acid); but the author himself states that he did not think he could say anything new. A discussion arose on this subject, the speakers being MM. Dumas and Chevreul. The former *savant*, in the first place, observed that the author had forgotten that carbolic acid was used largely, and that its application was compulsory in some instances, as well as the use of bleaching-powder. Phenic acid acts, said the eminent speaker, in a double way—viz., by arresting the decomposition of albuminous and other organic compounds, in a manner somewhat analogous to tannin; and, secondly, by killing organic, as well as organised, germs and sporules of all sorts—and thus acts as antiseptic. The speaker advocates the simultaneous application of chlorine (fumigations) and of carbolic acid. M. Chevreul spoke at length on the difference of mode of action of various antiseptics and disinfectants, calling, first, attention to the fact that sulphurous acid and sulphuretted hydrogen, when mixed together and decomposing each other, are mutually disinfectants; that hydrochloric acid and ammonia are in a somewhat similar relation to each other; that charcoal acts as antiseptic in a different manner—viz., by its capillary action; while the action of carbolic acid is chiefly confined to the material source of bad smell, but not to the bad smell actually itself. The venerable speaker next entered into a series of details of researches made by him as far back as the year 1809, on the action of tannin and tanning materials, and on the peculiar action exerted upon animal matters even by such substances as chloride of iridium, bichloride of mercury, chlorine-water, salts of alumina, glucina, and others, all of which possess, in a greater or less degree, astringent taste, and a peculiar property of combining with animal matters, and, as consequence thereof, acting as antiseptics and antimiasmatics.

**Observatory at Montsouris.**—H. Sainte-Claire Deville.—This *savant* communicates, with great regret, that, in consequence of the operations for the defence of Paris, this establishment has been dismantled, the instruments, books, and records having been placed in

safety, by order of Admiral Méquet, who is the commanding officer of that portion of the fortifications wherein this observatory (partly a wooden building) is situated.

**Proper Means of Counteracting the Effects of Insufficient Food.**—M. Rabuteau.—This paper, although strictly belonging to physiology, contains some very valuable matter on the beneficial action of coffee and cocoa. The author records a series of experiments and facts taken from actual daily experience; and he suggests that man may live for several months, and keep active, strong, and healthy, by consuming daily 150 grms. of a mixture (dry) of—Powdered cocoa, 1000 grms.; infusion of coffee, 500; infusion of tea, 200; sugar, 500 grms. The two infusions, as strong as can be made, to be evaporated to dryness previous to being mixed with the rest of the substances; so that the whole weight of this 2200 grms. would be only about 1600 grms., and would be sufficient food for ten days, to be taken mixed with some boiling-water. The author states that it is highly agreeable, he having purposely experimented with this mixture upon himself while abstaining from other food.

*Journal für Praktische Chemie*, No. 13, 1870.

This number contains the following original memoirs and papers:—

**Simple Method of Separating the Acids of Niobium and Ilmenium from each other.**—R. Hermann.—The author describes, at length, a process of separation of the bodies alluded to, which is based upon the more difficult solubility of the double fluoride of potassium and ilmenium, as compared with the solubility of the double salt of potassium and niobium, the former requiring 20 parts of water at 10° for solution, while the latter is completely dissolved by 15 parts of that fluid at the same temperature. The author also describes a great many of the soda-salts of both acids.

**Composition of the Columbite from Bodenmais (Bavaria).**—R. Hermann.—This paper contains the lengthy description of the method of analysis employed for determining the constituents of a mineral which, in 100 parts, contains—Stannic acid, 0.36; tantalous acid (*tantalize säure*), 24.23; niobic acid, 36.93; ilmenic acid, 18.84; protoxide of iron, 14.11; magnesia, 1.27; oxide of copper, 0.13.

**Composition of Ferro-Ilmenite, from Haddam, Connecticut, U.S.**—R. Hermann.—The mineral alluded to is a tough, compact substance, without any appearance of crystallisation; black-coloured; non-transparent; sp. gr., 6.28; and containing, in 100 parts—Stannic acid, 0.50; tantalous acid, 40.95; hypo-niobic acid, 16.23; hypo-ilmenic acid, 23.74; protoxide of iron, 14.30; protoxide of manganese, 4.28; and very small quantities of tungstic and titanous acids.

**Composition of Samarskite.**—R. Hermann.—This mineral, also belonging to the same series as those above alluded to, was found to contain, in 100 parts—Stannic acid, 0.35; titanous acid, 7.39; tantalous acid, 7.19; hypo-ilmenic acid, 19.84; hypo-niobic acid, 25.10; thorina, 4.47; yttria, 14.0; protoxide of uranium, 10.58; protoxide of iron, 10.70; magnesia, 0.34.

The above-quoted papers are valuable on account of the exhaustive description which is given of the methods of analysis of these very complex native compounds.

**On Isoclase and Kollophane, two New Phosphates.**—F. Sandberger.—The author begins by stating that, for more than eighty years there has been, in the mineralogical collection at Würzburg (Bavaria), a specimen kept labelled as "white arsenic," from Joachimsthal; it occurred to him that this might be an error, especially as the mineral did not exhibit quite the characteristics of white arsenic. After referring, at length, to purely mineralogico-crystallographical particulars, the following analysis is quoted of this mineral, the sp. gr. of which is 2.92—Water expelled at 100°, 2.06; water lost at red heat, 18.53; lime, 49.51; phosphoric acid, 29.90: formula,  $4\text{CaO} \cdot \text{PO}_5 + 5\text{H}_2\text{O}$ . The author states that he does not doubt that this mineral has really been found at Joachimsthal, in Bohemia, and desires that the attention of the Austrian mineralogists should be directed to that locality, where, perhaps a larger quantity of this mineral may occur. Kollophane is a peculiar mineral occurring at Sombrero (an island belonging to the United States), and consisting, in 100 parts, of—Water expelled at 100°, 3.36; water expelled at red heat, 1.66; lime, 50.70; magnesia, 0.80; phosphoric acid, 39.10; carbonic acid, 3.96.

The following subjects are all communicated by Dr. Böttger:—

**Anthracen Orange.**—While experimenting on the preparation of alizarine from anthracen, the author found a new compound, the constitution of which he has not yet fully ascertained; but the new body contains nitrogen, and is obtained by first preparing a nitro-compound of anthrachinon by treating that substance, in pure state, with a mixture of equal parts of very concentrated nitric and sulphuric acids, and submitting it to a temperature of 40°. The anthrachinon dissolves; and, as soon as dissolved, the liquid is poured into a large quantity of water, by which operation the pure nitro-compound is precipitated as a bulky, yellow-coloured, flocculent body. This, having been collected on a filter, and washed, is next placed in a porcelain basin, and there is poured over it a solution of protoxide of tin in caustic potassa or soda. This solution first causes the appearance of an emerald-green coloured fluid, which, on continued boiling, deposits the beautiful cinnabar-red coloured substance. This, after having been collected on a filter, and well washed and dried, fuses at about 225°, and sublimes as a beautifully red-coloured crystalline matter, soluble in acetic ether, acetone, chloroform, aldehyde, ordinary ether, alcohol, and wood spirit. This pigment is also soluble, without decomposition, in strong sulphuric acid, as well as in nitric acid (sp. gr., 1.2).

**Behaviour of Anthrachinon to Nascent Hydrogen.**—When anthrachinon is treated with pulverised metallic zinc and a boiling



solution of caustic potassa or soda, it is reduced to anthracen, with the exhibition of a very brilliant red colouration, which only subsists as long as it is in contact with zinc.

**Simple Method for Purifying Metallic Arsenic.**—In order to restore to this metal its bright aspect, and also for the removal of any slight coat of suboxide which may adhere to it, the author advises that the metallic arsenic should be boiled for a few minutes in a moderately-strong solution of bichromate of potassa, slightly acidified with sulphuric acid. The metal is next first washed with water, and then with alcohol or ether, and lastly placed in a small tube closed at one end, and sealed immediately after the arsenic has been put into it. Phosphorus, which has been kept a long time under water, and has become thereby coated with a whitish yellow crust, may be treated in the same way, when it becomes quite colourless again. The phosphorus should be, of course, carefully treated, so as to prevent its ignition; and, after having been well washed with cold water, should be preserved in water freed from air by having been previously boiled for a long time and cooled in a well-closed vessel.

**Behaviour of Protochloride of Copper when Electrolytically Decomposed.**—When protochloride of copper is placed in weak hydrochloric acid, and submitted to electrolysis, the electrodes being made of copper, the anode becomes covered with snow-white crystals of chloride of copper, while there is deposited on the cathode a thick layer of very loosely-adhering spongy metallic copper. When the latter is well washed, and next placed in a small flask along with a filtered solution of bleaching powder (hypochlorite of lime), that salt is partly decomposed, yielding, at first, very pure oxygen gas, but afterwards a gas (not specified) which extinguishes the light of a burning taper.

**Very Sensitive Test for Hyposulphites.**—Dissolve 1 decigram. of very pure permanganate of potassa, and 1 gram. of perfectly pure soda (prepared from sodium) in  $\frac{1}{2}$  a litre of distilled water; there is thus obtained a perfectly red-coloured liquid, which, upon the addition even of a very minute trace of any hyposulphite, becomes, at once, green. This test, the author states, is so delicate, that traces of a hyposulphite present in neutral sulphites may thus be detected.

**Employment of Pulverised Magnesium as a Powerful Reducing Agent.**—The chlorides of many metals are, when brought into contact with pulverised magnesium, readily reduced to the metallic state. Not only does this apply to the chlorides of gold and platinum, but even to that of zinc.

**Preparation of Coloured Cements which Harden Rapidly.**—The author takes a solution of silicate of soda (sp. gr., 1.298), and adds to it, whilst stirring, first pulverised and previously washed, lixiviated chalk, so as to form a thick mass, like butter, to which are added, for colouring purposes, the following substances:—Finely-pulverised sulphuret of antimony for black, iron filings for grey, zinc dust for whitish grey, carbonate of copper for bright green, oxide of chromium for deep green, cobalt blue for blue, red-lead for orange, vermilion for bright red, and carmine for a violet hue. This cement hardens within from six to eight hours, and may afterwards be polished, becoming like marble.

**On Diastatic Ferments.**—V. Wittich.

*Bulletin de l'Académie Royale des Sciences, des Lettres et des Beaux Arts de Belgique*, Nos. 6 and 7, 1870.

These numbers contain the following papers relating to physico-chemical and allied sciences:—

**Reports on the Researches of MM. Cornet and Briart on the Millstone-Grit of Bracquenies (Hainaut, Belgium).**—MM. d'Omalus, De Koninck, Dewalque, Horion, and Gosselet.—These papers are only of local geological interest.

**Elastic Force of Liquefiable Gases.**—M. Melsens.—This paper contains the results of a few researches made by the author while experimenting with condensed liquefied gases at higher temperatures, and employing, for the estimation of the pressure, metallic manometers. Liquid carbonic acid exerts, at 100°, a pressure equal to 228 and 86-100ths atmospheres (each atmosphere equal to 15 lbs. pressure per square inch). The author observes that, unless the space above the liquid gas be sufficient for the proper expansion of its vapour, the pressure, even at from 40° to 45° (equal to from 91 to 100 atmospheres), may rise to 300 atmospheres, and, consequently, become highly dangerous as regards the chance of explosions.

**Existence of Natural Pits in Senonian Chalk Formation of Brabant.**—F. van Horen.—This paper, illustrated by lithographed plates, treats on a subject before alluded to by us while quoting a former number of this periodical (see CHEMICAL NEWS, vol. xxii., p. 119).

**Vitality of Beer Yeast, and on the Vitality of the Jennerian Vaccine Lymph.**—M. Melsens.—As regards the beer yeast, the author states that his former experiments are fully confirmed (these experiments were made in 1866 and 1868). Jennerian vaccine lymph, exposed for an hour to artificially-obtained cold of -80°, was found to have preserved its vitality.

**Geological Description of the Empire of Morocco.**—M. Mourlon.—A lengthy essay, from which we learn that, among other industrially-valuable minerals, Morocco contains large deposits of rock-salt.

*Annalen der Chemie und Pharmacie*, July, 1870.

This number contains the following original papers and essays:—

**Researches on Isomerism in the Benzol Series.**—F. Beilstein and A. Kuhlberg.—Eleventh paper on this subject, divided into the

following sections:—Para-nitrotoluol,  $C_6H_4(NO_2)p.CH_3$ ; meta-nitrotoluol,  $C_6H_4(NO_2)m.CH_3$ ; dinitrotoluol-sulpho acid,  $C_7H_5(NO_2)_2SO_3H$ ; ortho-nitrotoluol,  $C_6H_4(NO_2)o.CH_3$ .

**Action of Bromine upon Dichlorhydrine.**—L. Carius.—After referring, at some length, to his former researches on this subject, the author describes two bodies, which result from the action of bromine upon dichlorhydrine. One of these substances is brom-dichlorhydrine, which it is difficult to obtain in pure state. The other body is dichlor-dibrom-acetone,  $C_3H_2Br_2Cl_2O$ ; in hydrated state, it contains  $(OH)_2$ , in addition; it is a very hygroscopic body, which crystallises in large crystals soluble in alcohol and ether, but difficultly so in water and benzol. The paper contains an exhaustive account of the reactions and products of decomposition and derivatives of this body.

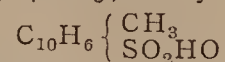
**On Toluylen-Oxide, or Desoxybenzoine,**  $C_{14}H_{12}O$ .—H. Limpricht and H. Schwanert.—This essay is divided into the following sections:—Toluylen-hydrate,  $C_{11}H_{14}O$ ; toluylen,  $C_{14}H_{12}$ ; acetyl-toluylen-hydrate,  $C_{14}H_{13}(C_2H_3O)O$ ; bromated toluylen-oxide,  $C_{14}H_{11}BrO$ ; bibromated toluylen-oxide,  $C_{14}H_{10}Br_2O$ .

**Benzilic Acid, or Diphenyl-Glycolic Acid.**—Dr. A. Jena.—This paper contains the detailed description of benzilic acid,  $C_{14}H_{12}O_3$ , a solid, crystalline body, fusing at 150°, readily soluble in alcohol, ether, and boiling water, but difficultly in cold water. The author also gives an exhaustive account of a series of the salts of this acid, and treats, at length, on diphenyl marsh gas (*sumpfgas*),  $C_{13}H_{12}$ .

**On Benzoine.**—A. Jena and H. Limpricht.—This memoir is divided into the following sections:—Acetyl-benzoine; toluylen-alcohol; ethyl-benzoine; ethyl-benzilic acid,  $C_{11}H_{11}(C_2H_5)O_3$ .

**On Dibenzoyl.**—Dr. A. Jena.—This paper contains the critical review of the labours of various experimenters on this body, which, according to the author, is by no means easily prepared; and its existence seems, judging from the results of his labours, somewhat doubtful.

**Homologues of Naphthalene.**—R. Fittig and J. Remsen.—This lengthy treatise contains the following chapters:—Methyl-naphthalene,  $C_{11}H_{10}=C_{10}H_7.CH_3$ ; methyl-naphthalene-sulpho acid—



behaviour of methyl-naphthalene with oxidising agents; ethyl-naphthalene,  $C_{12}H_{12}=C_{10}H_7.C_2H_5$ ; ethyl-naphthalene-sulpho acid—



**Contribution to Our Knowledge of some kinds of Sugar.**—H. Hlasiwetz and J. Habermann.—This memoir, too lengthy, like most of the preceding, for any useful abstraction, treats on—Glucose; formation of gluconic acid,  $C_6H_{12}O_7$ ; various salts of gluconic acid; sorbine; levulose; glycerine; phloroglucine.

*Bibliothèque Universelle et Revue Suisse.—Archives des Sciences Physiques et Naturelles* (No. 152), August 15, 1870.

This number contains the following original papers and memoirs relating to physico-chemical and collateral sciences:—

**Notice on the Levelling and Survey executed with very great Precision in Switzerland.**—MM. Hirsch and Plantamour.—This paper contains an interesting account of the labours of a committee of scientific men and engineers, who, acting upon the suggestion made at an international meeting held at Berlin, in 1864, under the presidency of General Baeyer, set to work to execute, in the Helvetian Republic, a complete and very accurate taking of levels and measuring of altitudes above sea level, and other geodesical labours. The observatory at Berne is situated at 572.14 metres above sea level; the cathedral of Fribourg at 588.66 metres; the town-hall at Chaux-de-Fonds at 989.35 metres.

**Glaciair Striae observed on the Fontainebleau Sandstone, near Paris.**—E. Collomb.—A geological essay.

*Bulletin Mensuel de la Société Chimique de Paris*, August, 1870.

From the *procès verbaux* of the meetings of this Society published in this number, we learn that M. Cornu exhibited an instrument constructed with the view to measure the rotatory power of various substances. In this instrument, the plane of polarisation is not determined by the extinction of an image, but by the equality of the tint of two adjacent images. M. Riban states that he has worked with this instrument, and determined, by its aid, the rotatory power of different samples of amylic alcohol and derivatives thereof. The amylic alcohol obtained from rice exhibited, at 22°, a rotatory power equal to -1° 18'; -1° 19'; -1° 20'; and, after having been heated to 240° for forty hours consecutively, the rotatory power of this alcohol was yet equal to -1° 18'; and, even when the alcohol was heated to 300° for 27 hours, its rotatory power was not perceptibly decreased. The valerianic aldehyde obtained from the levogyric alcohol was dextrogyric, exhibiting a rotatory power equal to +2° 34' (the sp. gr. of the liquid, at 22°, being 0.799, and its boiling-point 93°). The valerianic acid derived from this aldehyde has a rotatory power of +1° 53' (the sp. gr. of the acid, at 22°, is 0.43). Amylen exhibits no rotatory power at all.

This number contains the following original papers and memoirs:—

**Researches on the Ethers of the Arsenic Acids.**—J. M. Crafts.—This paper is identical with that already quoted (see CHEMICAL NEWS, vol. xxii., p. 96).

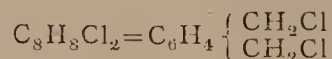


**Thermal Researches on Sulphur.**—M. Berthelot.—The contents of this paper have already been referred to by us from the *Comptes Rendus* (see CHEMICAL NEWS, vol. xxi., p. 214).

**New Method for the Synthesis of Organic Acids.**—M. Berthelot.—The direct action of the ethylenic and acetylenic carbides of hydrogen has the effect of first forming aldehydes and acetones. Any ulterior action produces monobasic acids, while the free hydrocarbons produce, under the influence of an alkaline permanganate, bibasic acids.

**Meta-Naphthalinc.**—M. Berthelot.—MM. Pelletier and Walter gave, some years ago, this name to a substance obtained from the tar from a resin gaswork. The author got, from M. Dumas, a sample of this substance, preserved in the Museum of the Sorbonne, and found, on testing its properties, that these agreed with the description thereof published by the first-named gentleman (see *Ann. de Chim. et de Phys.*, 2nd series, vol. lxvii., p. 298, 1838). The author found, on further investigation, that this meta-naphthaline is a mixture of various carbides, none of which are identical either with phenyl or any of the well-known carbides which are obtained from coal-tar. The substance in question, though beautifully crystalline, is an ill-defined mixture of a variety of bodies, the identification of which yet occupies the author.

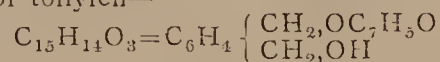
**An Aromatic Glycol.**—E. Grimaux.—This lengthy paper is divided into the following sections:—Chloride of tolylen—



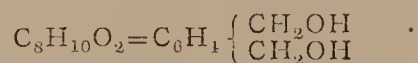
bromide of tolylen,  $\text{C}_8\text{H}_8\text{Br}_2$ ; iodide of tolylen,  $\text{C}_8\text{H}_8\text{I}_2$ ; diacetate of tolylen—



mono-benzoate of tolylen—



tollylenic glycol—



**Full Description of an Apparatus for Measuring Rotatory Power.**—A. Cornu.

**Decomposition of Oxalic Acid.**—M. P. Carles.—This paper is mainly the same as the author's memoir published in the *Comptes Rendus*, and quoted in CHEMICAL NEWS, vol. xxii., p. 58.

**Reply to the Critical Review of M. Reindel's Paper "On Ferrocyanides."**—G. Wyruboff.

**Some of the Properties of Albumen of Eggs.**—A. Petit.—After referring to researches on this same subject published some years ago, the author treats on the action of acids and alkalies on albumen, stating that these reagents, while combining with albumen, produce its dehydration, thus effecting a molecular rather than real chemical change. Animal charcoal (this is incidentally observed) has the property of absorbing albumen either from neutral, acid, or alkaline solutions; and this property, the author states, may be rendered available in analysis of vegetable and other substances.

*Les Mondes*, September 8, 1870.

**General Extension of the Dry Season of 1870.**—M. du Peyrat.—In a letter to M. Marié-Davy, the author states that he travelled from the Island of Réunion to Aden, thence through the Red Sea and the Suez Canal and the Mediterranean, and that during this twenty-six days' journey he has not felt a drop of rain. The ordinary rainy season at Réunion has been absent this year altogether, no rain having fallen for eleven months consecutively. At Aden, no rain had fallen for eighteen months; and the large rain-water cisterns which are kept for the purpose of water supply there were quite empty, and all vegetation had disappeared. The same was seen at Suez, and along the canal, except in the valley of the Nile.

**Health of Baron von Liebig.**—We are happy to learn that the health of this eminent *savant* is so far restored that, although very weak, he is able to take some exercise, and intends to go shortly to Engadine, Switzerland, to stay there and enjoy the fresh country air.

**Peat and Peat Bogs.**—M. Diesbach.—The author describes, at great length, a machine contrived to render the utilisation of peat as fuel a more readily manageable and, at the same time, economical business. He is at present very successfully engaged in working the peat bogs of Calsonayc Echallen, Canton du Vaud, Switzerland, producing a fuel which heats as much as absolutely dry wood. The author's machinery may be, perhaps, a boon to Ireland and other countries where peat bogs abound. From the statements made in this paper, there is no reason to doubt the efficacy, as well as the suitability of the process; Switzerland, moreover, is a country where fuel is scarce and cheapness a foremost requisite.

**Constant Galvanic Element with One Liquid.**—M. Delaurier.—This lengthy memoir, illustrated with woodcuts, contains the description of a series of experiments made with this galvanic element. The author employs—Chromate of soda, 5 parts; water, 40; and sulphuric acid, 14 parts.

*Journal für Gasbeleuchtung*, July, 1870.

This number contains the following original papers and memoirs relating to chemico-physical and collateral sciences:—

**Quantity of Water Yielded by Artesian Wells.**—A. Thiem.—This paper is a lengthy essay reviewing the various algebraical formulæ relating to hydrostatics and hydrodynamics.

**Construction of Gas Meters according to the Metrical System; and on the Conversion of Gas Meters made upon the English and Rhénish Cubic Foot System into Metres according to the Metrical System.**—T. Spilchagen.

**Tin-Lined Lead Tubing.**—Dr. Schilling.

## NOTES AND QUERIES.

**Soap Making.**—I am a "soft soap" maker, and am anxious to have a book or treatise on the subject, or on soap-making generally and oils and fatty matters; can you direct me to the best? Also, particularly, the experiments of Mr. Clift (referred to in CHEMICAL NEWS, vol. x., p. 55) for the "sweetening of fish oils."—J. Y.

**Artificial Alizarine.**—I should feel favoured if any correspondent would kindly answer the following:—In the year 1861, provisional protection was obtained for the manufacture of artificial alizarine by Mr. T. J. Roussin. His process was by acting on what he called binitro-naphthaline (obtained by causing naphthaline to react upon a mixture of azotic and sulphuric acids) with concentrated sulphuric acid and a metal. I should like to know if there was any foundation for this specification; if so, the nature of the colouring matter produced (specification, May 17th, 1861; No. 1266). These attempts are interesting now that the manufacture of alizarine has become an accomplished fact.—R. G. BENNETT.

**Decomposition of Fulminate of Mercury.**—(Reply to "C. H.")—This compound, which consists of 86 per cent of suboxide of mercury, and 14 per cent of fulminic acid, can be readily decomposed, so as to prevent any danger of explosion, by treating it, for instance, with hot nitric acid, whereby carbonic and acetic acids are formed and nitrate of mercury; or, by applying hydrochloric acid, whereby mercuric chloride and mercurous oxalate are formed. Moderately dilute sulphuric acid also decomposes it without detonation, but with rise of temperature and evolution of gas. The ensuing mercuric compounds can be readily converted into metallic mercury, by boiling with water in a clean iron vessel containing iron nails.

**Hard and Soft Water.**—Two or three weeks ago, a communication appeared in one of the leading journals, recommending the use of soft water in drinking and cooking purposes. Whatever value such an opinion may possess in a scientific point of view, there is reason to fear that, practically, it is not without danger to the public health. There is an idea, very prevalent amongst the non-informed portion of the public, that "soft water" means *rain-water*, which generally washes the blacks and other impurities from the tops of houses before it is drawn for use, and is certainly not the purest channel for conveying drinking-water into our houses. As the paragraph referred to was circulated freely at the time of its appearance, a few words of caution from you, Sir, may put people on their guard.—SANITAS.

**Decomposition of Nitrate of Ammonia.**—Would you inform me, through your Answers to Correspondents, what the products or educts of the distillation of nitrate of ammonia are, besides  $\text{N}_2\text{O}$ ; is it possible to get  $\text{N}_2\text{O}_5$  (nitric anhydride) and  $\text{N}'_2\text{O}_2$  (nitric oxide). A friend makes the  $\text{N}_2\text{O}$  for anæsthetic purposes, and employs three Wolff's jars; the first, nearest the retort, he has  $\text{KHO}$  or  $\text{NaHO}$  in, to take up nitric acid or anhydride, which he says is formed (would not  $\text{OH}_2$  absorb it?); the other has a solution of  $\text{SO}_2\text{FeO}$  to purify the  $\text{N}_2\text{O}$  from  $\text{N}'_2\text{O}_2$ . Is he correct? From what I have read in Dr. Frankland and Fownes, under the article  $\text{N}_2\text{O}$ , the equation is thus:— $\text{NO}_2(\text{N}'\text{H}_4\text{O}) = 2\text{OH}_2 + \text{ON}_2$  (Frankland's). Would you (if this equation is incorrect) give me a proper equation, and oblige—A YOUNG STUDENT.

## TO CORRESPONDENTS.

**T. H. Page.**—The work is not published yet; it is a general work on Dyeing, &c.

**Subscriber.**—It is considered successful.

**J. Slessor.**—The allowance will be made.

**W. Arnot.**—Received.

**J. Edwards.**—The notice appears in this week's number.

**Water-glass, or Soluble Silicates of Soda**  
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# THE CHEMICAL NEWS.

VOL. XXII. No. 567.

## ON THE DISCRIMINATION OF FIBRES IN MIXED FABRICS.\*

By JOHN SPILLER, F.C.S.

It is often a matter of importance to separate or distinguish the fibres of silk, wool, cotton, jute, &c., when interwoven, or composing the structure of mixed fabrics, and much progress has been made towards the identification of such fibres by the close examination of them under the microscope. With the view of aiding such enquiries, I beg leave to point attention to some new chemical tests, by means of which the character of the component fibres in mixed goods may be very readily determined. At the outset, I may state that there are many processes of examination which are already known to, and employed by, practical dyers, such methods usually depending upon the comparative facility with which certain colouring matters are taken out of a dye-bath, by virtue of special affinities exerted between one or other of the component fibres and the dyes exhibited; thus it is well known that indigo, and soluble blues and violets of the aniline series, attach themselves to wool much more freely than to cotton, whilst safflower and regina have a decided affinity for cotton.† The nitric acid test for wool is also well known and often applied, but the use of dilute alkalies for dissolving out wool from silk and cotton has never, in my hands, given satisfactory results.

I proceed at once to indicate the test upon which I rely for the identification of silk when mixed with any other animal or vegetable fibres, which test can, of course, be applied to the detection of inferior staple in a supposed pure silk. The reagent employed is concentrated hydrochloric acid, which I find has the property of dissolving silk immediately and completely, without appreciably affecting any woollen or lignine fibres (cotton, linen, jute, &c.) with which the silk may have been interwoven. Strong sulphuric acid has also a powerful solvent action upon silk, but its effect upon cotton is much more destructive than in the case of hydrochloric acid. The use of these acids for the purpose of testing the quality of silk has been frequently resorted to by my friend, Mr. James Kayess, of the Garratt Print Works, near London, and myself during the past three years, and, in conjunction with the gentleman I have named, the original experiments were made upon which the efficacy of this method of testing silk was clearly established.

Having, then, submitted the material to the action of hydrochloric acid, and noted any indications of rupture or solution of the fibres, the residual fabric or loose filaments may now be washed and collected, and will usually be destitute of colour. We have next to determine the presence or absence of wool in that portion of the fabric which resists the attack of hydrochloric acid; and, for this purpose, I know of no better test than the use of picric acid, as recommended by Professor Pohl, of Vienna, and fully described in Watts's "Dictionary of Chemistry," vol. v., p. 1047. A warm aqueous solution of picric acid instantly imparts a full yellow tint to wool, but does not in the least affect cotton, linen, jute, or China grass, so that it is only necessary to immerse the fabric or fibres in the dye, wring out, and wash well with water in order to remove the adhering yellow solution, and note any indications of the existence of wool. I have

ascertained that cotton may be so treated without retaining any trace of the colour, and that a previous digestion in hydrochloric acid in no way affects the result. In the examination of ribbons, and some other stiffened goods, it is often necessary to immerse them for a few minutes in boiling water, to dissolve out the starch or size prior to applying the hydrochloric acid test, for, by this simple expedient, the results are rendered much more decisive.

The above will be deemed the readiest mode of proceeding, but it will be well to mention other methods of distinguishing between wool and cotton. We can use, for instance, an acidulated solution of Hofmann violet or of soluble blue; iodine green may be employed, or, lastly, the Nicholson blue, which, applied in alkaline solution, is much more readily taken up by wool than by cotton. As means of confirmation, the use of any one of these dyes may be resorted to, and a direct comparison instituted, if necessary, with known materials.

By the system of examination just now described, I have examined a large series of mixed fabrics and coloured goods, without observing any difficulty in the detection of the silk and wool entering into the constitution of such materials. With respect to the identification of the fibres which remain unaltered by this treatment—the discrimination of cotton from flax, for instance—I have hitherto relied upon their structural peculiarities as indicated more conspicuously by the microscope, and this part of the subject has, besides, been fully treated of by Mr. W. T. Suffolk, in his recent work, entitled "Microscopical Manipulation."

By way of conclusion, I append a short description of the chemical properties of the solution obtained by acting upon silk with hydrochloric acid. The mucilaginous liquid so prepared cannot be evaporated, even over a water-bath, without becoming somewhat carbonised; the free acid may be partially separated by dialysis, or by exposure to air in a shallow capsule, placed within a bell-jar charged with a liberal supply of slaked lime to absorb the hydrochloric fumes, but the resulting solution will not then bear dilution with water without precipitation of the animal matter. Ammonia, added in excess, forms a clear solution, which I am hopeful of being able to employ in photography, for when this liquid is evaporated there is left a brown saline residue of rough astringent flavour, which, when mixed with aqueous nitrate of silver, gives a peculiar flocculent form of argentic chloride, which is no longer curdy, and much more rapidly affected by light than the ordinary condition of chloride of silver. These properties enable the silk-compound to be usefully employed in the production of "matt-paper" prints and direct solar-camera enlargements. Its application to the colloidal-chloride process appears also to be worthy of trial.

When caustic soda in excess is added to the silk-solution, and afterwards a small proportion of the sulphate, or, better, the sodio-tartrate, of copper, a fine purple colouration is observed, which is permanent, and seems to afford a characteristic indication of the nature of the animal substance dissolved. No red cuprous oxide is thrown down upon boiling this solution. A white precipitate is formed when the solution of silk is neutralised with a caustic or carbonated alkali, and the product exhibits a considerable affinity for dyes, as does also the mixed substance resulting from the addition of an acid solution of silk to an alkaline solution of wool. In the latter case, however, the evolution of sulphuretted hydrogen will be noticed as an unfavourable feature of the reaction, and probably indicates the breaking up of the constitution of the wool. The brownish uncrystallisable residue left upon evaporation of the pure silk-solution reacts strongly acid to test-papers, and has, whilst warm, an odour suggestive of caramel; when strongly heated, it burns with a brilliant flame, giving off the well-known odour of singed hair or feathers, like many other nitrogenous animal substances. The preparation of the new silk-compound on a large scale, and in the state of purity, has

\* Read before the British Association, Liverpool Meeting, Section B.

† The new "Spiller purple" likewise shares the property here referred to, going well upon cotton without any mordant.



hitherto presented difficulties on account of the peculiar nature of its properties, and the liability to become charred in the process of evaporation.

ON THE  
SEPARATION OF PHOSPHORIC ACID FROM  
IRON ORES AND IRON CINDERS.\*

By JAMES HARGREAVES.

I NEED not here enter into any lengthened description of the evil effects of phosphorus upon iron; suffice it to say that iron containing phosphorus in appreciable quantities is utterly unfitted for the manufacture of steel, and is considerably deteriorated whether it is used in the form of cast or malleable iron. Hence it is desirable to get rid of the phosphorus to prevent this deterioration.

This subject had to some extent attracted my attention for several years, but not so far as to make it a matter of special study and experiment, but, about five years ago, my attention was more closely drawn to the subject, and I proposed the use of alkaline nitrates as a means of converting cast-iron into steel, and, at the same time, separating any phosphorus that might be present. By the use of nitrate of soda I have found it to be quite practicable to produce a good serviceable steel direct from phosphoric pig.

The process, however, was not carried out on a real working scale, for reasons entirely apart from its technical merits, to explain which would be to go into personal matters, which are quite foreign to the objects of this association. But while engaged in the attempt to develop this steel process, the fact forced itself upon my attention that phosphorus had hitherto been too much looked upon as something to be *got rid of*, and not sufficiently as something to be *got hold of*; and that to effect the latter would be the best means of effecting the former. It was talked of and regarded by the iron manufacturers as "dirt," but that was because it was "matter in the wrong place," and the only way to make it cease to be dirt was to put it in the right one. I felt this to be a matter of considerable importance, and have often pressed as a subject of study by my fellow chemists, some commercially practical means of obtaining the phosphorus either alone or in some of its available compounds. I pointed this out in a paper read before the Liverpool Polytechnic Society in November, 1867, and again before the Cleveland Institute of Engineers, at Stockton-on-Tees, in March, 1868. But at the latter place I was simply ridiculed for even alluding to anything so very preposterous, the very fact that there was such an immense amount of phosphoric ores consumed being quoted as a reason why the proposal should be considered impracticable. I refer those who are interested in this subject to the *Engineer* for the earlier part of 1868, for copies of the papers read at Liverpool and Stockton.

It seems, however, that no one has, so far as I can learn, thought proper to give this subject the attention which it deserves—not even those who are most interested in it, and whose opportunities and inducements must be very much greater than my own. In fact, it has almost seemed as if those who would naturally be expected to take the greatest interest in the subject are the last to pay any attention to it. It is one which I was anxious to see carried into practical operation, no matter by whom, as I looked, and still look, upon it as a question of not only pecuniary, but what is immeasurably greater, of vital importance, one affecting health and life, for, in the absence of phosphates, no bony frames can be formed to cover with muscles and endow with vital force; and one of the limits which bound the existence of man and the lower animals is the quantity of phosphoric acid which

can be made available and used as a vital "circulating medium."

I need not dilate upon the importance of a large and practically exhaustless source of phosphoric acid, especially so long as our municipal authorities continue to make use of our streams as convenient conveyances to deposit our supplies of phosphates in the sea, instead of using the sewage to re-fertilise the soil which has been exhausted in the production of food. Seeing this waste (which is nothing less than criminal) one would imagine that we did not expect to be followed by future generations, or else that some one had invented some improvement on the work of the Omnipotent, and the framework of the bodies of future generations were to be built up without the use of phosphates at all. By proper utilisation and conservation of the elements of food, whether in the form of excretal matters or of mineral substances, it is possible that to make "every rood of ground maintain its man" may be not only the aspiration of a poet, but a matter of sober fact.

As an illustration of the quantity of phosphorus which is present in the iron made in Great Britain, I may point to Cleveland, which manufactures  $1\frac{1}{2}$  millions of tons of iron per annum. This iron, at the low estimate of  $1\frac{1}{4}$  per cent, contains 18,750 tons of phosphorus, which is equal to 42,943 tons of phosphoric acid. This phosphoric acid is sufficient to supply the phosphoric constituents to 3,400,000 tons of wheat. In the absence of strict statistics on the subject, it is not too much to assume that, in the whole of the British iron manufacture, this quantity might be tripled, with every confidence that it is considerably under rather than over the fact.

When phosphoric pig-iron is converted into malleable iron, the phosphorus is, in great part, transferred to the refinery and puddling furnace cinder in the form of phosphate of iron. The quantity of phosphoric acid varies of course with the composition of the pig-iron from which it is contained. The cinder produced from refining and puddling Cleveland pig contains generally from 3 to 7 per cent of phosphoric acid, which is from one-fourth to one-half the phosphoric acid present in good commercial soluble phosphate of lime. This cinder is sometimes again used for the manufacture of pig-iron, but the product is, on account of the accumulation of phosphorus, of small commercial value, while, if the phosphoric acid were previously separated, it would be capable of yielding iron quite equal to that produced from hæmatite, or could be again used for "fettling" puddling furnaces.

While at this part of the subject I may refer to the contradictory and incoherent theories given to account for the separation of phosphorus from the iron and its transference to the cinder while being converted into malleable iron by the ordinary refining and puddling processes, while in the Bessemer process the amount of phosphorus separated is very small. I could get no satisfactory explanation from other sources, and, therefore, made these reactions a subject of study and experiment for over three years, and I gave the results in a paper read before the Liverpool Polytechnic Society. To repeat this would extend this paper to too great length, and I must refer those who take an interest in the subject to the *Journal* of the Society for May, 1869.

The concentration of the phosphorus from the pig into the cinder in the form of phosphate of iron renders it more easy and practicable to separate when the preparation of compounds of phosphoric acid is the object in view, as there is a smaller bulk of material to be treated to obtain a given amount of product.

The phosphoric acid may be separated either in the form of soluble superphosphates of lime and magnesia or of the alkaline tribasic phosphates. To effect the former the cinder is melted with lime and magnesia; and to do this it is best to either use lime in the furnace during puddling, or else add it at the end of the operation before the cinder is run out, so as to save the fuel required to re-melt it. This is then roasted in the ordinary way of

\* Read before the British Association, Liverpool Meeting, Section B,



making what is technically called "bull-dog." By this roasting the protoxide of iron is converted into magnetic oxide or into peroxide of iron, both of which are very slowly soluble in cold dilute hydrochloric acid, while the phosphate of lime is readily dissolved out, leaving the oxide of iron and silica behind. Or, instead of fusing the cinder with lime, it is first dissolved in hydrochloric acid, the silica being left behind insoluble, except a small proportion of gelatinous silica; sufficient lime or chloride of calcium is added to saturate the whole of the phosphoric acid present in the cinder. The chloride of iron is then concentrated to dryness. If in an open reverberatory furnace and in an atmosphere containing water vapour, hydrochloric acid is again liberated, which can be condensed and used again to dissolve more cinder. The peroxide of iron is then heated to redness to render it insoluble, and cold dilute hydrochloric acid added, which dissolves out the phosphate of lime, leaving the oxide of iron nearly pure. If it is desirable to obtain the chlorine in its isolated state instead of in the form of hydrochloric acid, the chloride of iron is dried in a close vessel, and dry atmospheric air passed through it at a temperature about the melting-point of zinc; the chlorine is liberated and peroxide of iron formed. The manufacture of chloride of lime or bleaching-powder can, therefore, be economically carried on in connection with the manufacture of phosphates and pure iron oxide, dispensing with the use of manganese, and with the further advantage that a given amount of hydrochloric acid will produce double the amount of chlorine that can be produced by the use of manganese. To obtain phosphate of soda, I keep the cinder free from lime and grind it to a powder, then I add a solution of caustic soda in good excess, so as to separate the whole of the phosphoric acid from the cinder before throwing the cinder out, and add the solution of phosphate and excess of caustic soda from that to an excess of cinder, so as to convert the whole of the caustic soda into phosphate. The partially exhausted cinder is then again treated with an excess of caustic soda to separate the whole of the phosphoric acid. The diphosphated cinder still contains the silica originally present, and it seems to combine with some of the soda used to dissolve out the phosphoric acid, as there is often 20 per cent of the soda used remaining in the cinder. This cinder may be again used to fettle puddling furnaces, and the soda present in it cannot but facilitate the transformation of the phosphorus in the pig into phosphoric acid in the cinder; the presence of the silica, however, is objectionable, on account of its neutralising a great proportion of the bases present in the cinder. It is desirable that the cinder produced from the fettling and the iron together should be as free as possible from anything which can saturate the basic material, so as to allow of a greater amount of free base, which readily facilitates the formation of phosphate of iron. To allow of this when making phosphate of soda, I dissolve the cinder the same as before mentioned, leaving the insoluble silica behind. The chloride of iron is then dried and used in the production of chlorine, or the hydrochloric acid may be again recovered to use over again. The oxide of iron, *plus* phosphate of iron obtained after the separation of the chlorine, is then treated with caustic soda to obtain solution of phosphate of soda, the practically pure oxide of iron remaining insoluble. The phosphoric acid in the iron ores exists principally as phosphate of lime, which, in fact, is the remains of extinct animals. To separate the phosphate, the ore is roasted so as to render the oxide of iron insoluble. The ore is broken into suitable sized pieces, say about 2 inches cube, and cold dilute hydrochloric acid run through it, which takes up the phosphate into solution, leaving the oxide behind.

The limit to the manufacture of the acid phosphate is, practically, the quantity of hydrochloric acid which is produced in the manufacture of sulphate of soda, over and above what is required for the manufacture of bleaching-powder and a few other purposes. The exact quantity

of this acid I have not had time to ascertain with any degree of accuracy, but in the alkali works on the Mersey, and it is much the same in other places, there are literally brooks of hydrochloric acid run to waste; besides, the fact that the acid at present used in the manufacture of bleaching-powder can, by the use of chloride of iron process, be reduced to one-half and, in many cases, to less than one-third, its present quantity, will liberate a still further supply of acid to be used in the preparation of acid phosphates. There is here an opening for the consumption of a great amount of valuable material which is at present run to waste. There is, of course, no practical limit to the further production of hydrochloric acid, whatever may be the quantity required, if a rise in price should occur sufficient to justify its special manufacture, and the manufacture of phosphate of soda is also unrestricted so far as supplies of soda are concerned.

The only objection to the use of such hydrochloric acid as is produced in the course of the alkali manufacture is the presence of arsenic. This, however, is practically a small difficulty, the same person who produces the hydrochloric acid also produces sulphide of calcium in the shape of alkali waste. A current of sulphide of hydrogen (which can easily be produced from the waste) passed through the acid readily precipitates the arsenic in the form of orpiment, for which there is a regular demand at remunerative prices. The separation of the arsenic will, if fairly attempted, more than pay for the cost of obtaining it.

#### ON MARBLES FROM THE ISLAND OF TYREE.\*

By EDWARD C. C. STANFORD, F.C.S.

TYREE is one of the few islands in the Hebrides where limestones are found, and two varieties are sufficiently remarkable to form the subject of this note. Both occur at Balephetrish, on the north-west side of the island, and near the coast. One of these occurs as a beautiful pink marble with dark green spots, and this, I believe, is unknown in any other part of the world.

The pink colour is due to peroxide of iron, and the dark green spots, which vary in quantity considerably in different specimens, are crystals of horn-blende. Three selected specimens accompanying this paper illustrate this variety. It takes a good polish, and two small polished pillars of it may be seen in the British Museum. There is difficulty, however, in procuring large slabs, as these generally contain some pieces of horn-blende, several inches in diameter and difficult to polish. It is a beautiful marble for inlaying in small pieces; its effect is well shown inlaid in a fine white marble mantelpiece in Inverary Castle. The white marble is too hard for ordinary working, but, as a facing-stone for exterior work, it would be almost imperishable.

The proportion of magnesian is remarkable.

The horn-blende in the pink, and the silica in the white, are variable.

	Pink.	White.
Calcium carbonate .. ..	70.85	50.70
Calcium sulphate .. ..	trace	—
Magnesium carbonate .. ..	2.35	37.92
Peroxide of iron .. ..	3.40	—
Calcium phosphate .. ..	—	0.80
Silica .. ..	—	10.18
Horn-blende .. ..	23.40	—
Water .. ..	—	0.40
	100.00	100.00

The peroxide of iron is scarcely soluble in dilute hydrochloric acid, which leaves most of the colouring matter.

\* Read before the British Association, Liverpool Meeting, Section B



ON THE  
EXISTENCE OF TWO SPECTRA PRODUCED BY  
CARBON INCANDESCENT AT THE SAME  
TEMPERATURE.\*

By W. MARSHALL WATTS, D.Sc.,  
Physical Science Master in the Manchester Grammar School.

ONE of the most interesting questions in the present stage of spectral analysis is the cause of the differences which are observed in the spectra of certain elements. The changes which can be brought about in the spectrum of a substance, by altering the conditions under which it is produced are of three kinds:—

(1). Simple addition of new lines—for example, the addition of the blue line to the lithium spectrum when the electric light is employed instead of the flame.

(2). Replacement of bands by groups of well-defined lines possessing generally nearly the same refrangibility—for example, the changes which take place in the spectra of strontium and calcium when they are produced by the electric spark instead of the flame.

(3). Total alteration of the spectrum—for example, the primary and secondary spectra of nitrogen, as described by Plücker and Hittorf.

There can be no doubt that changes of the first class are due simply to change of temperature; that is to say, at the higher temperature other atomic vibrations are set up simultaneously with the vibrations to which the lines of the lower temperature are due.

Changes of the second class are probably due to chemical decomposition. Thus, the broad bands of the calcium spectrum observed at the lower temperature of the flame are probably produced by the glowing vapour of calcium oxide; whereas, at the high temperature of the intense electric spark, the oxide is decomposed, and the metal vapour gives the fine lines which take the place of the bands.

Changes of the third class are more difficult of explanation.

They have been observed by Plücker and Hittorf, in the case of hydrogen, nitrogen, sulphur, selenium, phosphorus, and iodine; and by Wüllner, in the case of hydrogen, oxygen, and nitrogen. Wüllner has recently shown that hydrogen is capable of giving at least four different spectra. These different spectra of hydrogen are all obtained by the use of electricity; and both Plücker and Wüllner believe the changes to be caused by change of temperature. Thus Plücker says—"There is a certain number of elementary substances which, *when differently heated*, furnish two kinds of spectra not having any line or any band in common;" and Wüllner writes—"The difference of temperature must, in the case of hydrogen, be regarded as the sole cause of this phenomenon, for a decomposition into further elements is not to be thought of."

Carbon exhibits changes of spectrum, not only of the first and second classes but also of the third. I believe that I have obtained evidence that two of these spectra are produced at the same temperature.

Firstly, as to the evidence that each of these spectra is actually the spectrum of carbon itself, and not of any compound of carbon. The first of these spectra is shown to be that of carbon, inasmuch as it is common to olefiant gas, cyanogen, and carbonic oxide. It can be obtained from any one of these gases, by passing the electric spark through it, but is obtained most brilliantly by burning olefiant gas (or cyanogen) with oxygen in an oxyhydrogen jet. The second spectrum is shown to be that of carbon, inasmuch as it can be obtained alike from carbonic oxide, olefiant gas, or carbonic disulphide, and is most easily obtained from a Geissler's tube enclosing coal-gas.

The temperature of the first carbon spectrum is obtained with a certain degree of accuracy from the temperature of flames which give it.

The temperature of any flame can be calculated on the assumption that the whole heat of combustion is expended in raising the temperature of the products of combustion. The calculated temperature of a flame can never be less than the actual temperature, but is, in many cases, considerably too high, in consequence, principally, of dissociation; but the calculated temperatures are generally less in error when the combustion takes place in air, than when it takes place in oxygen. This will be seen from the following comparison of the results of calculation with the experimental results in those few cases in which trustworthy experimental results have been obtained:—

*Combustion in Oxygen.*

	Calculated flame temperature.	Experimental.
	°C.	°C.
Hydrogen .. ..	6880	2844
Carbonic oxide ..	7067	3033

*Combustion in Air.*

	Calculated.	Experimental.
	°C.	°C.
Hydrogen .. ..	2738	2024
Carbonic oxide ..	2996	1997
Cyanogen .. ..	3519	3297

The first carbon spectrum is obtained from the flame of olefiant gas in air, the calculated temperature of which is only 2619° C. No experimental determination of this temperature has been made. It is also obtained from the flame of a mixture of cyanogen and carbonic acid, the calculated temperature of which is 2016°; and can also be obtained from the inner blue cone of a Bunsen flame, the temperature of which is shown to be less than 2000° C., because, although it is capable of melting a fine gold wire (fusing-point 1300° C.), it refuses to melt the finest platinum wire (fusing-point 2000° C.).

The same spectrum (with the addition of some lines) is obtained from the flame of cyanogen in air, the temperature of which is determined, by calculation, to be 3519° C., and by experiment, 3297°. It is also obtained from the flame of cyanogen in oxygen, the calculated temperature of which is 10,557° C. We may therefore conclude that this spectrum is produced at any rate between the temperatures of 2000° C. and 3000° C.

The second carbon spectrum is obtained only by the use of electricity, and the difficulty of measuring the temperature of the ignited gas is great. I have sought to overcome this difficulty, by including sodium vapour with the gas in the Geissler's tube. We can hardly refuse to admit that the temperature of the ignited sodium vapour must be the same as that of the carbon compound; and the sodium spectrum contains certain lines, visible only at high temperatures, from which the temperature can be determined.

If the temperature to which the sodium vapour be heated be sufficiently high, the spectrum contains, besides the well-known double line, four other lines, each of them double; I denote these lines as Naβ, Naγ, Naδ, and Naε. In the Bunsen flame, the D lines only are obtained; but, if the temperature of the flame be increased, these other sodium lines come out one by one, and in the order given above. I find that Naβ becomes visible almost precisely at the temperature at which platinum melts—that is, 2000° C.; so that, if a bead of sodium carbonate be brought into any flame incapable of fusing platinum, only the D lines will be seen, but, if the flame be hot enough to fuse platinum, Naβ will also be visible.

For example—

The Bunsen flame gives the D lines only, and is incapable of fusing platinum.

The flame of coal-gas, fed by a jet of air mixed with a little oxygen, gave Naβ, but not Naγ. The flame fused platinum easily.

The flame of carbonic oxide in air (temperature, 1997° C.) gave only D; it is incapable of fusing platinum. Carbonic oxide fed by oxygen (temperature 3033° C.) gives Naβ and Naγ.

\* Read before the British Association, Liverpool Meeting, Section A.



We conclude, therefore, that Na $\beta$  indicates a temperature of at least 2000° C., and that Na $\gamma$  comes out about 3000° C.

If now the discharge of an induction coil be passed through a Geissler's tube containing carbonic oxide and sodium, the carbon spectrum No. 2 is obtained; and if the sodium be volatilised, the sodium lines come out one by one as the tube gets hot, and the carbon lines are seen simultaneously with Na $\beta$ , and (at first) without Na $\gamma$ . Hence we conclude that this second spectrum is also produced by carbon between the temperatures of 2000° and 3000° C. I do not presume to attempt an explanation of this difference of vibration at the same temperature. In view of the fact that the second spectrum is produced only by means of electricity, the question suggests itself—Whether the atomic vibrations of the gas produced by the electric discharge are different in kind from the vibrations which we measure as temperature? Or, if a very crude hypothesis may be allowed, I would suggest that identity of temperature means identity of molecular vibration, but that the light emitted is caused by the inter-molecular vibration of atoms. If this hypothesis be admitted, a test experiment suggests itself. If, by increase of temperature, the velocity of the molecules of a gas be increased, the refrangibility of the light, caused by the vibrations of their constituent atoms, ought to be slightly increased in the motion of the molecule towards the observer, and slightly diminished in the motion of the molecule from the observer; so that a line ought to become broader when the temperature of the source of light is increased.

If, then, the slit of a spectroscope be partly illuminated with sodium-light from a flame of low temperature, and partly from the intense electric spark, the D lines should exhibit a less interval in the latter case than in the former. A rough calculation shows that, if the temperature of the flame be 2000° C., and of the spark 10,000° C., the interval between the two sodium lines ought to be diminished by about one-twentieth. I have endeavoured to detect this difference, but the dispersive power of the spectroscope at my disposal (a three-prism instrument, kindly lent by my friend Mr. S. Okell) was not great enough.

## ANALYSIS OF SOME HITHERTO UNDETERMINED AMERICAN MINERALS.

By Professor LEEDS.

### I.

A GREENISH-WHITE, translucent, compact mineral, from Van Arsdale's quarry, near Attleboro', Bucks County, Pennsylvania, previously regarded as Ekebergite.

#### Percentage Composition.

Sp. gr., 2.71.					
SiO <sub>2</sub>	..	..	..	..	47.47
Al <sub>2</sub> O <sub>3</sub>	..	..	..	..	27.51
Fe <sub>2</sub> O <sub>3</sub>	..	..	..	..	trace
MgO	..	..	..	..	1.20
CaO	..	..	..	..	17.59
Na <sub>2</sub> O	..	..	..	..	3.05
K <sub>2</sub> O	..	..	..	..	1.40
H <sub>2</sub> O	..	..	..	..	1.48

99.70

The atomic ratio, obtained by multiplying the quotients of these per cents by the atomic weights into the equivalences of the radicals, is—

Si	..	..	0.790 × 4 = 3.16	..	..	3.16 or 12.
[Al <sub>2</sub> ]	..	..	0.270 × 6 = 1.62	..	..	1.62 or 6.
Mg	..	..	0.030 × 2 = 0.06	..	..	—
Ca	..	..	0.310 × 2 = 0.62	..	..	—
Na <sub>2</sub>	..	..	0.050 × 2 = 0.10	..	..	—
K <sub>2</sub>	..	..	0.015 × 2 = 0.03	..	..	—
H <sub>2</sub>	..	..	0.080 × 2 = 0.16	..	..	0.97 or 4.

Excluding the percentage of water, as has been done hitherto in the computation of the formulæ of these and analogous silicates, we have for the atomic ratio, 1 : 2 : 4. If we deduct the amount of Si corresponding to the H<sub>2</sub>, regarding the matter as existing in the mineral in the form of hydrate of silicic acid, we again have the ratio 4 : 6 : 12, and the formula (Ca, Na<sub>2</sub>)<sub>2</sub>[Al<sub>2</sub>]Si<sub>3</sub>O<sub>10</sub>. And the mineral is Scapolite.

The same mineral is found in the locality mentioned above, in imperfect crystals with rough faces. It is associated with pyroxene, graphite, sphene, and phlogopite in granular limestone.

### II.

A variety of orthoclase, which is described by I. Lea\* as being of a dull bluish-green colour, and semi-transparent, with very minute crystalline hexagonal plates disseminated through the mass, and giving out very bright reflections. These plates may be seen with the naked eye. The name proposed for this variety was *cassinite*. It is found in a ploughed field on a serpentine ridge known as Blue Hill, in Upper Providence Township, Delaware County, four miles north-west of Media.

#### Percentage Composition.

SiO <sub>2</sub>	..	..	..	..	..	64.20
Al <sub>2</sub> O <sub>3</sub>	..	..	..	..	..	19.69
Fe <sub>2</sub> O <sub>3</sub>	..	..	..	..	..	0.69
CaO	..	..	..	..	..	2.27
MgO	..	..	..	..	..	0.15
K <sub>2</sub> O	..	..	..	..	..	9.59
Na <sub>2</sub> O	..	..	..	..	..	3.43
H <sub>2</sub> O	..	..	..	..	..	0.27

100.29

Its formula is (K<sub>2</sub>, Na<sub>2</sub>) [Al<sub>2</sub>]Si<sub>6</sub>O<sub>16</sub>, the same as common orthoclase.

### III.

A yellowish white mineral, with rhombohedral cleavage and vitreous lustre, occurring imbedded in steatite. It is associated with a ferruginous dolomite, and often intermixed with it: becomes brown on exposure. It is found at the soapstone quarry on the north-east bank of the Schuylkill river, on the line between Philadelphia and Montgomery County.

#### Percentage Composition as given by the Mean of Two Analyses.

MgO	..	..	..	..	..	38.43
FeO	..	..	..	..	..	10.39
CaO	..	..	..	..	..	3.29
CO <sub>2</sub>	..	..	..	..	..	47.96

100.07

It is to be regarded, therefore, as a ferriferous magnesite, or breunerite.

My thanks are due to Mr. Theodore D. Rand, who obtained the specimens of these three minerals at the localities, and kindly presented them to me for analysis.—*Journal of the Franklin Institute.*

## ON THE NUMBER OF ISOMERIC BODIES.†

By O. LOEW.

THE rational formulæ of organic combinations differ so much among themselves at the present time, and are occasionally so incomprehensible, and on no reasonable ground, that it is of the greatest importance to organic chemistry when a man of Kolbe's learning undertakes to reconstruct the rational formulæ on as natural a basis as possible, and in correspondence with the true characters of bodies.

\* *Proceedings of the Academy of Natural Sciences of Philadelphia*, 1866.

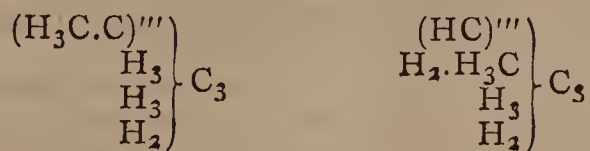
† Communicated by the Author.



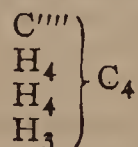




III. Tricarboic Radicals.



IV. Tetracarboic Radical.



NOTE ON THE SPECTRA OF ERBIA AND  
SOME OTHER EARTHS.\*

By WILLIAM HUGGINS, LL.D., F.R.S.

BAHR and Bunsen have shown† that erbia, rendered incandescent in a Bunsen's gas-flame, gives a spectrum of bright lines in addition to a brilliant continuous spectrum. As they were unable to discover the bright lines in the flame beyond the limits of the solid erbia, they suggest that the light which is dispersed by the prism into bright lines is emitted by the solid erbia, which substance therefore appears to stand alone, as a remarkable exception, among solid bodies. Bahr and Bunsen found the spectrum of bright lines to coincide very nearly with the absorption spectrum of some compounds of erbium.

A few weeks since, when in Ireland, I made the observation that the spectrum of the ordinary lime-light contains bright lines.‡ Dr. Emerson Reynolds, Director of the Laboratory of the Royal Dublin Society, kindly undertook to make experiments to ascertain from the position of the lines if they were due to the cylinder of lime, or to impurities contained in it.

Upon my return to town I made the following experiments; shortly after commencing them I received from Dr. Reynolds the account of his experiments, which, with his permission, I have added to this note.

**Erbia.**—A few months since I received, through the kindness of Dr. Roscoe, F.R.S., a few grains of nitrate of erbia, which he had procured from a trustworthy source. I followed Bunsen's method of placing it with syrupy phosphoric acid upon a platinum wire. The erbia, obtained by this method in a finely divided state, was then submitted to the heat of the oxyhydrogen blowpipe.

In all the experiments described in this paper hydrogen alone was first turned on, and the effect of the heat of the flame on the substance under examination observed with the spectroscop. Oxygen was then admitted slowly, and the effect of the increased heat carefully noted.

With the flame of hydrogen alone, the lines represented in the map which accompanies Bahr and Bunsen's paper were seen, but the lines were more distinct when a small proportion of oxygen was admitted. With the full proportion of oxygen, the light from the glowing erbia was more intense, but the lines were not so well seen. Even with the intense heat of the oxyhydrogen flame I was unable to trace the lines beyond the limits of the solid erbia, though the line of sodium could be seen for some distance from the erbia. I found, however, that the lines appeared more distinct, in consequence, probably, of their being brighter relatively to the parts of the continuous spectrum where they occur, when the slit was directed from the side upon the gas immediately in front of the glowing part of the erbia.

The spectrum of bright lines obtained by means of the oxyhydrogen flame agreed more completely with the absorption spectrum represented by Bahr and Bunsen

(No 2 in their diagram) than the spectrum of bright lines figured by those observers (No. 3). The most important differences occurred in the band in the red, which showed two points of greatest brightness, thus forming a double line with a little outstanding light, and the line at the green at 65 of the scale, which was double, precisely as the corresponding absorption-line is represented in spectrum No. 2 of the diagram.

**Lime.**—The experiments were made with the cylinders of lime prepared for use with the oxyhydrogen blowpipe, and also with pieces of pure caustic lime, but there was no sensible difference presented in the spectroscop.

The bright lines consisted of a double line in the green, and several bands in the orange and red, which were found to form a spectrum identical with that which is produced when chloride of calcium is heated in the flame of a Bunsen's burner.

When the spectroscop was directed to a point in the flame a little above the incandescent portion of the lime, the lines appeared beyond the bright continuous spectrum, showing that they are not produced by the white-hot solid lime, but by the luminous vapour into which a portion of the lime has been converted by the heat of the flame.

**Magnesia.**—The commercial heavy oxide of magnesium was made into a paste with distilled water, and formed into a small pellet upon the end of a platinum wire. The pellet of magnesia was slowly dried, and then placed in the oxyhydrogen flame. I was surprised to see a spectrum of bright lines precisely similar to that which is produced by lime. Chloride of magnesium, when introduced into the Bunsen flame, gave a similar spectrum. I record these results as the oxide and chloride were those sold as pure. I found afterwards that a very small trace of lime may be detected in magnesia by means of the oxyhydrogen flame.

I then took metallic magnesium, which I had found by the spectroscop to be nearly pure, and formed from it magnesia and chloride of magnesium.

When this magnesia, formed into a small ball upon a wire, was subjected to the oxyhydrogen flame, two bright bands were seen in the green. One of these was found to be coincident with the triple line of Fraunhofer's *b*, which distinguishes magnesium, and the other with a group of bright lines which is seen between *b* and *F*, nearly in the position of the brightest double line of nitrogen, when metallic magnesium is burnt in air.

The chloride formed from magnesium, when introduced into the Bunsen flame, gave the same bands, but the more refrangible band was exceedingly faint.

When an induction-spark was taken from a wire covered with cotton-wool soaked with a solution of the chloride, the lines at *b* and the more refrangible group were seen. If the heating-power of the spark be increased by the introduction of a Leyden jar, the band between *b* and *F* becomes scarcely distinguishable, while the lines peculiar to metallic magnesium are much more intense. When a spark is taken between electrodes of the same specimen of magnesium from which the chloride was formed, no trace of this band was detected.

**Baryta.**—When pure caustic baryta is subjected to the heat of the oxyhydrogen flame, a brilliant spectrum is seen identical with the well-known spectrum which presents itself when chloride of barium is heated in the Bunsen flame. Baryta furnishes a larger quantity of vapour than lime and magnesia, and therefore the lines could be traced to a greater distance from the solid baryta.

**Strontia.**—Pure strontia was fused into a large bead upon a platinum wire. When this bead was heated by the oxyhydrogen flame, the same spectrum of bright lines presented itself as is seen when chloride of strontium is placed in the flame of a Bunsen's burner.

**Zirconia.**—One of the small pellets of zirconia prepared in France for use with the oxyhydrogen blowpipe was found to give no trace of bright lines. This great fixity of zirconia as compared with lime is in agreement with the inalterability of the substance under the action of the oxyhydrogen flame.

\* From the *Proceedings of the Royal Society*, No. 122, 1870.

† Liebig's *Annalen*, Bd. lxi. (1866) S. 1.

‡ Dr. W. Allen Miller informs me that in 1845 he noticed a bright line in the spectrum of the diffused light of the oxyhydrogen jet reflected from a sheet of paper.



*Alumina*.—Pure alumina treated in the same way as the magnesia gave a continuous spectrum only, without any trace of bright lines.

*Glucina*.—Glucina gave a bright line in the red, which I found to be due to potassium. Glucina, therefore, appears not to form vapour of any kind under the heat of the oxyhydrogen blowpipe.

*Titanic acid* gave a continuous spectrum without lines.

*Oxide of uranium* a continuous spectrum without lines.

*Tungstic acid* a continuous spectrum without bright lines.

*Molybdic acid* a continuous spectrum without bright lines.

*Silica* (precipitated) a continuous spectrum without bright lines.

*Oxide of cerium* a continuous spectrum without bright lines.

The question presents itself as to the nature of the vapour to which the bright lines are due in the case of the earths, lime, magnesia, strontia, and baryta. Is it the oxide volatilised? or is it the vapour of the metal reduced by the heat in the presence of the hydrogen of the flame? The experiments show that the luminous vapour is the same as that produced by the exposure of the chlorides of the metals to the heat of the Bunsen gas-flame. The character common to these spectra of bands of some width, in most cases gradually shading off at the sides, is different from that which distinguishes the spectra of these metals when used as electrodes in the metallic state.\*

Roscoe and Clifton have investigated the different spectra presented by calcium, strontium, and barium, and they "suggest that at the lower temperature of the flame or weak spark, the spectrum observed is produced by the glowing vapour of some compound, probably the oxide, of the difficultly reducible metal; whereas, at the enormously high temperature of the intense electric spark these compounds are split up, and thus the true spectrum of the metal is obtained. In none of the spectra of the more reducible alkaline metals (potassium, sodium, lithium) can any deviation or disappearance of the maxima of light be noticed on change of temperature."†

As the experiments recorded in this paper show that the same spectra are produced by the exposure of the oxides to the oxyhydrogen flame, Roscoe and Clifton's suggestion, that these spectra are due to the volatilisation of the compound of the metal with oxygen, is doubtless correct.

The similar character of the spectrum of the bright lines seen when erbium is rendered incandescent would seem to suggest whether this earth may not be volatile in a small degree, as is the case with lime, magnesia, and some other earths. The peculiarity, however, of the bright lines of erbium, observed by Bahr and Bunsen, that they could not be seen in the flame beyond the limits of the solid erbium, deserves attention. My own experiments to detect the lines in the Bunsen gas-flame, even when a very thin wire was used, so as to allow the erbium to attain nearly the heat of the flame, were unsuccessful. The bright line in the green appears, indeed, to rise to a very small extent beyond the continuous spectrum, but I was unable to assure myself whether this appearance might not be an effect of irradiation.

It is, perhaps, worthy of remark that the chlorides of sodium, potassium, lithium, caesium, and rubidium, give spectra of defined lines, which are not altered in character by the introduction of a Leyden jar, and which, in the case of sodium, potassium, and lithium, we know to resemble the spectra obtained when electrodes of the metals are used. Now, all these metals belong to the monad group; it appeared, therefore, interesting to observe the behaviour of the other metal belonging to this group.

Chloride of silver when introduced into the Bunsen flame gave no lines. The chloride was then mixed with alumina, which had been found to give a continuous spectrum only, and exposed to the oxyhydrogen flame, but no lines were visible. When, however, the moistened chloride was placed on cotton and subjected to the induction-spark without a jar, the true metallic spectrum was seen, as when silver electrodes are used.

The behaviour of silver, therefore, is similar to that of the other metals of the monad group. Now, the difference in basic relations which is known to exist between the oxides of the monatomic and polyatomic metals would be in accordance with the distinction which the spectro-scope shows to exist in the behaviour of the chlorides; the chlorides of the polyatomic metals would be more likely to split up in the presence of water into oxides and hydrochloric acid.

In the case of some of the oxides and chlorides, one or more of the lines appeared to agree with corresponding lines in the metallic spectra; it may be, therefore, that, under some circumstances, as in the case of magnesium burning in air, the metallic vapour and the volatilised oxide may be simultaneously present.

#### Dr. Reynolds's Experiments.

"After you observed the occurrence of two bright lines in the spectrum of the light emitted by incandescent lime, you recollect we identified these as belonging to calcium. At the time we supposed that these lines were produced by the ignition of the vapour of some volatile calcium compound probably present as an impurity in the sample of limes used in the experiments. If this explanation was found to be true for lime, the bright lines seen in the spectrum of erbium might possibly be accounted for in a similar manner. In order to examine the matter fully, I arranged the experiments described below.

"I selected two oxides for comparison with erbium, viz., lime and magnesia. As it seemed desirable to prepare these oxides in precisely the same manner as the erbium, some calcium and magnesium nitrates were made chemically pure to ordinary tests, and then used in the preparation of the respective oxides.

"The oxyhydrogen flame was employed as the chief source of heat. The hydrogen was made from zinc and sulphuric acid in the usual way, and the oxygen from potassium chlorate. As both gases are certain to be contaminated with traces of acids, I took the precaution of passing each gas through a long tube filled with fragments of solid potassium hydrate. If this plan were not adopted, the traces of acid which would find their way into the hydrogen or oxyhydrogen flame might produce volatile compounds with the earths, and so lead to mistakes.

"1. *Experiments with Magnesia*.—A loop of stout platinum wire was moistened with syrupy phosphoric acid, and some magnesium nitrate made to adhere. The nitrate was then heated in the hydrogen flame, and a residue of magnesia obtained. No lines were observed in the spectrum of the light emitted by the incandescent earth, and when the latter was intensely heated in the oxyhydrogen jet only a continuous spectrum was seen.\*

"2. *Experiments with Lime*.—A platinum wire, of the same thickness as the last, was moistened with the phosphoric acid, some calcium nitrate was then taken up in the loop, and heated in the hydrogen flame until a residue of lime was obtained. At the outset, the calcium-spectrum was observed, but the light speedily gave only a continuous spectrum. The lime and loop of wire were kept well enveloped in the hydrogen flame for nearly half an hour, in order to ensure the complete decomposition of the nitrate. During this time, no lines could be detected on the background of the continuous spectrum, or in the spectrum of

\* For the spectra of metallic strontium, barium, and calcium, see *Phil. Trans.* 1864, p. 148, and Plates 1 and 2. Both forms of the spectra of these substances are represented by Thalen in his "Spektralanalyse."

† Roscoe's "Spectrum Analysis," p. 175, and *Proc. Lit. and Phil. Soc. Manchester*, April 1, 1862. See also A. Mitscherlich, "Ueber der Spectren der Verbindungen," S. 10.

\* "Since writing the above, I have succeeded in observing the bright lines described by Mr. Huggins as occurring in the spectrum of the flame surrounding the incandescent magnesia. In the earlier experiments I probably admitted too much oxygen to the mixed gas-flame in the first instance."



the flame surrounding the lime. More hydrogen was now turned on, and oxygen slowly admitted, the light being examined with the spectroscope during the time. When the proportion of oxygen had reached a certain point, faint traces of the two brightest Ca lines appeared on the bright background, and the intensity of these lines increased with the amount of oxygen admitted up to a definite extent. When a certain proportion of oxygen was exceeded, the lines became less distinct. The best results were obtained when the hydrogen was decidedly in excess of the oxygen in the flame—that is to say, more than in the proportion of 2 : 1.

“When the slit of the spectroscope was pointed in such a way that only the light from the flame surrounding the incandescent lime entered the instrument, all the Ca lines and bands were observed with great ease without a continuous spectrum. On looking at the mantle of flame with the naked eye, it was easy to perceive a reddish tinge. I next maintained the small fragment of lime at the highest temperature its supporting wire was capable of resisting for *three hours*; at the end of this time, the Ca lines were as strongly marked as before, and the lime on the wire had very appreciably diminished in amount. The same results were obtained when no phosphoric acid was employed to attach the calcium nitrate to the wire in the first instance.

“Again, a piece of well-burned quicklime, of very small size, was heated alone on a platinum wire for more than an hour, and the bright Ca lines were seen during the whole time.

“From the results of these experiments, we must draw the conclusions—(1) that, when lime is sufficiently heated, the light which it emits is derived in part from the incandescent solid, and partly from ignited vapour; (2) that lime is either volatile *as such*, or that in the first instance it suffers reduction by the excess of hydrogen in the flame, the luminous vapour of calcium then giving its own peculiar spectrum.

“3. *Experiments with Erbium*.—The specimen of erbium nitrate which you kindly gave me was attached to a platinum loop with syrupy phosphoric acid, as usual, and decomposition of the salt effected in the plain hydrogen flame. After heating for a short time in this way, the chief green line of erbium became visible, but seen upon the continuous spectrum. Oxygen was now turned slowly into the flame. As the temperature rose, two of the other bright lines of the earth were seen. The best observations were made when the oxyhydrogen flame had hydrogen in excess, and the erbium was kept in such a position that it was very strongly ignited. The erbium lines were most distinctly seen when the slit of the spectroscope took in the light from the extreme edge of the incandescent solid. When the bright lines were best observed, the continuous spectrum was relatively faint. Again, when the slit was made to cut the edge of the ignited bead of the earth, the strong green line of erbium was seen to extend to a very small, but appreciable, distance above or below (as the case might be) the continuous spectrum. I could only observe this for the strong line. I failed to get any trace of lines in the spectrum of the flame beyond the incandescent erbium.

“The erbium was next heated in the oxyhydrogen flame to the maximum temperature that the wire would bear for *three and a half hours*, but the green line was seen to be just as strongly marked at the end as at the beginning of the experiment. The bulk of the erbium was so much reduced by this treatment, that I have now scarcely a trace left.

“From the results of these experiments, I think we must conclude—(1) that the light emitted by incandescent erbium is derived chiefly from the ignited solid, but that the bright lines observed in its spectrum have, as their source, a luminous vapour of extremely low tension at even the highest temperature of the oxyhydrogen flame; (2) that this interrupted spectrum belongs either to erbium or to its oxide.

“If these conclusions are true, it follows that erbium is not an exception to the ordinary law.

“It would appear that, in these experiments, three substances have been employed, varying in their degree of volatility. At the temperature of the oxyhydrogen flame, magnesia appears to be less volatile than lime; but I am in doubt what relative volatility to assign to erbium, since its spectrum of bright lines can be seen when the earth is heated in the plain hydrogen flame, and yet at the much higher temperature of the oxyhydrogen jet the volume of luminous vapour does not appear to materially increase.

“Finally, we have yet to learn whether or not in all these cases reduction of the oxide precedes volatilisation; if reduction takes place, the luminous vapour must be that of the metal. The settlement of this question would no doubt be very difficult. But I rather incline to the view that the vapour whose spectrum is obtained on igniting these earths is that of the metal; for I find that the bright lines are most easily observed when hydrogen is present in excess in the oxyhydrogen flame. Moreover, the actual amount of matter volatilised on very prolonged heating is really very small, and this circumstance appears to favour the view that a slow surface-reduction is in progress.”

## OBITUARY.

### WILLIAM ALLEN MILLER.

PROFESSOR MILLER, of King's College, London, died at Liverpool, of apoplexy, on Friday, the 30th of September. He left London on the 13th of September for the British Association, and was taken ill on the journey.

William Allen Miller was born at Ipswich, in Suffolk, on the 17th of December, 1817. He was carefully educated by his mother, who seems to have imparted to her son much of her own quiet, sagacious nature. He spent one year in Merchant Taylors' School, and two years in a school belonging to the Society of Friends, at Ackworth, in Yorkshire, where lectures on elementary chemistry were delivered, and from which young Miller imbibed a taste for that science. He was also much impressed with the phenomena of the stars as seen through a telescope which one of the masters used to exhibit to the pupils. These early impressions bore fruit in the chemistry of the stars, with which his name is now permanently associated. His training at Ackworth imparted to his manner that quiet simplicity which marks the members of the Society of Friends. At the age of fifteen he was apprenticed to his uncle, who was surgeon to the General Hospital at Birmingham. After five years he entered the Medical Department of King's College, where his knowledge of chemistry attracted the attention of Professor Daniell, who during the illness of the laboratory assistant engaged his services. This was the turning point in his career. In 1839 he gained the Warneford Prize for the encouragement of theological studies among medical students. In 1840 he visited Germany, and passed some time in Liebig's laboratory at Giessen. In the same year he was appointed to the post of Demonstrator in the Laboratory of King's College. In 1841 he became Assistant Lecturer to Professor Daniell, and also took his degree of M.D. in the University of London. He also assisted Professor Daniell in various scientific enquiries, and conducted the experiments on the electrolysis of saline compounds, his name being associated with that of Daniell in the paper that appeared in the *Phil. Trans.* for 1844. In the following year he became a Fellow of the Royal Society, and on the death of Professor Daniell succeeded to the vacant chair. During a quarter of a century, he continued to lecture with unceasing activity, and to take part in the management of the College, every one, from the Principal



and Professors to the youngest student, being anxious to obtain his advice and assistance. It was impossible to come into contact with him without feeling oneself in the presence of a man of pure nature, of spotless integrity, of sound and sagacious judgment, and of true gentlemanly feeling. His loss will be deeply felt, especially in King's College; in the Royal Society, of which he was Treasurer and Vice-President; in the Mint, and the Bank of England, where he was one of the Assayers. He will be missed in the Courts of Law, where his clear perception of patented processes and his strong sense of justice made him respected alike by Judge and Counsel. He will be missed by the manufacturers who sought his advice; but most of all he will be missed by the few friends who had his confidence. There is no man since Faraday whose loss will be so much mourned and regretted. He was buried at Norwood Cemetery on Wednesday last by the side of his wife, whom he survived one year. He died on the anniversary of her burial.

Prof. Miller bore his honours lightly; but perhaps it would be wrong to omit that he received the degree of LL.D. at the University of Edinburgh; that of D.C.L. at the University of Oxford, in June, 1868; and that of LL.D. at the University of Cambridge, in May, 1869, after giving the Reade Lecture. He also received the gold medal of the Astronomical Society, in conjunction with his friend and fellow worker, Mr. Huggins.

C. T.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

*Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

[In consequence of the war on the Continent, several of the foreign journals have failed to reach us; we shall, however, give abstracts of them as soon as they are received.]

*Annalen der Chemie und Pharmacie*, August, 1870.

This number contains the following original papers and memoirs:—

**The Iva (*Achillea Moschata*).**—Dr. A. von Planta-Reichenau.—The subject of this memoir is a celebrated plant, a native of the Swiss mountains, and for centuries has been in high repute as a medicinal agent. The author first refers briefly to some historical facts bearing upon the Iva and its use; and then states that, as nothing is yet known in reference to the chemistry of this substance, he, having an excellent opportunity to procure the herb, undertook the exhaustive research of the same. The lengthy memoir treats on essential oil of Iva, which, in the crude state, has a bluish green colour, a taste somewhat akin to oil of peppermint, while its smell is not disagreeable; its sp. gr., at 15°, is 0.9346; formula,  $C_{26}H_{40}O$ . The pure oil, boiling at between 170° and 210°, is a pale yellow-coloured fluid, exhibiting a peculiar strong ethereal smell; its taste is bitter, but, at the same time, like peppermint; the formula of the pure substance is  $C_{24}H_{40}O_2$ . Ivain, an oleo-resinous bitter matter, readily soluble in water and alcohol, is the hydrate of the Iva oil. Stearic acid is also present in the herb, and, moreover, three other substances, which the author has called achilleine, moschatine and achillettine, the latter being the product of the decomposition of achilleine. This latter is a peculiar alkaloid, containing  $C_{20}H_{38}N_2O_{15}$ .

**Analysis of the Water of the Thermal Spring of Ragaz-Pfäfers.**—Dr. A. von Planta-Reichenau.—The spring alluded to is situated in the Canton St. Gall, Switzerland. The taste of this water is like that of warm distilled water; its temperature, at the source, 37.5°; sp. gr., 1.0003. 10,000 parts of this water contain—Sulphate of potassa, 0.0746; sulphate of soda, 0.3294; chloride of lithium, 0.0020; chloride of sodium, 0.4934; iodide of sodium, 0.0001; bromide of sodium, 0.0002; borate of soda, 0.0038; carbonate of soda, 0.0613 (all carbonates have been calculated as monocarbonates); carbonate of lime, 1.3064; carbonate of magnesia, 0.5306; carbonate of strontia, 0.0152; carbonate of baryta, 0.0064; carbonate of protoxide of iron, 0.0172; phosphate of alumina, 0.0091; silica, 0.1408; traces of rubidium, cesium, and thallium—Total of solid constituents, 2.9905. 10,000 c.c. of the water con-

tain 119.2 c.c. of gas, consisting, in 100 parts, of—Carbonic acid, 16.43; oxygen, 24.24; nitrogen, 59.33.

**Non-Existence of Chlor-Cyanhydrogen.**—A. Naumann and E. Vogt.—This paper treats, at length, on the question, whether the chlor-cyanhydrogen,  $2CyCl.CyH$ , can and does exist; and the conclusion the authors have come to, after a lengthy series of experiments, is, that it does not exist as a definite chemical compound.

**Uroxanic Acid, and the Chemical Constitution of Uric Acid.**—Dr. A. Strecker.

**Behaviour of Chloride of Platinum towards Lime and Baryta-Water.**—E. Johannsen.—This lengthy essay treats on a series of binary compounds which lime and baryta form with chloride of platinum. The paper, an excellent monograph on this subject, contains the results of a great number of analyses. The main result is that platinum has a greater affinity for chlorine than calcium and barium.

**Formation of Chloro-Maleic Acid from Benzol.**—Dr. L. Carius.—The author describes, first, a series of reactions of the hydrate of chloric acid upon benzol, resulting in the formation of various bodies, among which monochlor-maleic acid,  $C_4H_5ClO_4$ , a crystalline substance, readily soluble in water, alcohol, and ether; fusing at 171°; boiling at 180°. This acid is bibasic. The author describes, at great length, several of its salts, some of which crystallise very readily.

**Two Metallic Derivatives of Glycerine.**—Dr. P. Schotländer.—This lengthy monograph treats on the preparation and constitution of some compounds of glycerine, or, rather, the radical glyceryl,  $C_3H_5$ , with manganese, sodium, potassium, and strontium.

*American Journal of Pharmacy*, September, 1870.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

**Most Delicate Colour-Test for the Detection of Strychnia.**—W. T. Wenzell.—After referring at some length to the great variation of the precise limit of the sensibility of the colour tests usually applied for the detection of strychnia, and also discussing the best form of using and manner of applying these tests, the author says—In testing for minute portions of the alkaloid, it is a desideratum to use a reagent the proportionate relations and superior sensitiveness of which will admit of the successful demonstration of traces of the poison. In experimenting towards that end, I have found that a solution of 1 grain of permanganate of potassa in 2000 grms. of sulphuric acid is, *par excellence*, the test for that purpose. The author gives, further, a lengthy account of a series of experiments, instituted with various reagents, for the purpose of testing the delicacy of each of these for the detection of strychnia, the result being that the limit of positive recognition by the bichromate of potassa and sulphuric acid test may be placed at 1-100,000th, that of the chromic acid test at 1-600,000th, and that of the permanganate at 1-900,000th. As regards the use of the permanganate, the author distinctly states that the honour of its discovery belongs to Dr. Wm. A. Guy, of London.

**Phosphate of Lime in Acetic Acid.**—W. H. Bruckner.—The author relates that, while engaged in analysing a sample of Charleston guano, he had occasion to use acetic acid, and, finding the results of his analysis unsatisfactory, and differing too much, he found, on testing the acetic acid (sold as chemically pure), to contain a not inconsiderable quantity of phosphate of lime; but the percentage of this impurity present was not determined, neither is any clue given to the way in which this material came to be present in the acid.

**Production of Iodine and Bromine.**—W. H. Chandler.—After referring at length to the various sources from which the two haloids alluded to are derived, the author mentions a few instances of the quantity of the elements above named present in some of the waters of saline springs in the United States, where iodine and bromine were first discovered in 1830—the former body in the Saratoga spring-waters, and the latter in the salines of Onondaga. The quantity of bromine in the Saratoga spring-waters, as determined by Professor Chandler, reaches 3.63 grms. per gallon; in a brine of the Saginaw valley, Dr. Chilton found 7.65 grms. of bromine; while at Tarentum, Pa., 6 grms. of bromine and 4 grms. of iodine were reported by M. Hieren. Bromine is, we learn further from this paper, manufactured in the United States in considerable quantity; that for the current year will amount to 125,000 lbs. Iodine is not at present manufactured in the States, the supply being obtained from Europe, where its manufacture is confined to Great Britain and France; the annual production of these countries amounts to 200,000 lbs. The average product of iodine is 10 lbs. to the ton of kelp; and, since it requires 20 tons of wet seaweed to produce 1 ton of kelp, this total represents 400,000 tons of seaweed. At the present price, the iodine produced is of more value than the alkaline salts. The chief consumption of bromine and iodine is for medicinal purposes, in the form of salts; a small proportion is consumed in photography. Bromine has been proposed as a discharge in calico-printing, and was, to a limited extent, used as a disinfectant during the late American war.

**New Sulphur Deposit.**—A. B. Taylor.—The deposit here alluded to is in the Island of Saba, a country of volcanic origin its highest point being about 2800 feet above sea level. In this island, a Netherlands' possession, sulphur was recently quite accidentally discovered by an enterprising New Yorker, who visited the island in search of health. With the aid of some of the natives, he succeeded in quarrying about two sloop-loads of the crude mineral, which, on being brought to New York, was found to yield, on average, rather over 60 per cent of sulphur, while the Sicily mineral only yields about 30 per cent. The deposit is, considering the small size of the island, very extensive, and is of great value for the manufacturing interests of the United States; and, since the island is distant only about 1500 miles from New



York, it need not be wondered at that leases have been secured of the best tracts of sulphur deposit there by American firms.

**Roasting of Coffee.**—W. Procter.—When a cold prepared extract of roasted coffee is distilled with lime or magnesia, an alkaline distillate is obtained, which, by evaporation, after the addition of hydrochloric acid, and extracting with alcohol, yields a pure chloride of methyl-ammonium. This product is formed by the decomposition of caffeine when combined with tannic acid, as is the case in all coffees; pure caffeine yielding different products of decomposition, among which is cyanogen. In roasting coffee, a portion of the caffeine is volatilised together with some methylamine, while the larger amount remains with the coffee itself; half of the caffeine of the coffee is decomposed in this way. One sample which, before roasting, was found to contain 1.45 per cent, yielded afterwards only 0.65 per cent. The temperature at which these changes are effected is, in the case of Porto Rico, or green coffee, 275°, and in that of Java, yellow coffee, 250° to 255°. Caffeine is soluble in bisulphide of carbon and benzol, and in the latter menstruum to such an extent, that it may be used with advantage to prepare the pure alkaloid from raw coffee.

**Snake Poison and its Antidote.**—S. B. Higgins.—To this paper, although not an original one, having been published in the *Chemist and Druggist* (London, June 15, 1870), we call the attention of those of our readers who happen to reside in countries where venomous snakes abound. The main gist of the contents of the memoir is, that the poisons of the poisonous snakes, and all animal poisons, have their specific antidote in the gall of the animal or reptile in which these poisons exist. The pure gall is mixed with very pure and very strong alcohol (95 per cent); 200 drops of that liquid, mixed with 20 drops of the gall, are thoroughly mixed; and of that mixture 5 drops are given at a time in half a tumblerful of water.

*Neues Jahrbuch für Pharmacie, von Dr. F. Vorwerk* (double number) May and June, 1870.

This number contains the following original papers and memoirs:—

**Preparation and Constitution of Hyoscyamine in relation to the other Constituents of Semina Hyoscyami.**—H. Hohn.—This lengthy monograph treats, in the first place, on the preparation of hyoscyamine from henbane seeds, carefully collected and fresh; secondly, the properties and composition of hyoscyamine are considered. The author found that hyoscyamine possesses, in a very high degree, the property of dilating the pupil of the eye; the alkaloid is precipitated by chloride of platinum only from concentrated solutions, and an excess of the platinum-salt re-dissolves the precipitate. The formula of the hyoscyamine is  $C_{36}H_{23}N_2O_6 + HO$ ; and the author states that this body may be viewed as atropine, 1 atom of H of which has been replaced by 1 atom of methyl-ammonium,  $C_2H_5, H_2N$ ; and the formula of hyoscyamine may therefore be written—



The memoir further contains the following chapters:—Researches on a waxlike material obtained by the first purification of hyoscyamine in chloroform. The body herein alluded to has been called by the author, hyoscerine, a body fusing at about 210°, devoid of taste and smell, not sublimable, insoluble in water, readily soluble in strong boiling alcohol, and best so in ether and chloroform; the formula of this substance is  $C_{32}H_{20}O_6$ . Hyoscyamus seeds, moreover, contain a peculiar glycoside. Hyoscypikrine, a peculiar volatile base, and a yellow-coloured nitrogen-containing resin; formula,  $C_{112}H_{63}N_2O_{20}$ .

**Establishment and Capital required for the Manufacture of Artificial Mineral Waters, and on the Profits of that Trade.**—Dr. E. Gressler.—This paper is a valuable contribution to our knowledge on this subject in a technical point of view; but, as regards the financial part of that business, it is only applicable to a portion of Germany.

**Chemical Researches on the Fruit of the Laurel-Herb (*Daphne genkwa*), and more especially on a Fatty Oil contained therein.**—Dr. A. Casselmann.—This monograph is divided into the following divisions:—Investigation of the fatty oil.—This is a so-called drying oil, present in the fruit of the above-named plant to a percentage varying from 24 to 31.3; sp. gr. of the oil at 15°, 0.8903; not solidified at -16°, and not altered by a temperature of 160°. When freshly pressed, this oil has a smell resembling that of cantharides; its taste is very acrid, but, by exposure to air for a few days, these characteristics are lost, owing to a change the oil undergoes by oxidation. The oil is readily soluble in ether, sulphide of carbon, and benzol, but very difficultly so in strong alcohol. This chapter treats, further, at great length, on the composition and constitution of this oil, the elementary constitution of which is expressed, in 100 parts, by—C, 76.69; H, 11.05; O, 12.26. The next division of this memoir treats on the investigation of the residue of the fruit after having been deprived of its fixed oil; and on the preparation of coccognine, a crystalline white-coloured body, readily soluble in alcohol, but not so in water; also soluble in ether. The composition of the fruit of the laurel-herb (a poisonous plant) is, in 100 parts—Ethereal, or essential oil, a trace; fixed drying oil, 31.0; resin and wax soluble in ether, 3.58; an acrid resin soluble in alcohol, 0.32; coccognine, 0.38; proteine compounds, 19.5; gum, mucilage, malic acid, bitter and colouring matters, and cellulose, 32.37; an organic matter (salts), 5.46; water, 7.39—total, 100.00.

**Eau de Beauté de M. Bargasse.**—Eau de beauté consists of—Bichloride of mercury, 80 centigrms.; camphor, 1 grm.; sulphate of zinc and solution of lead (*liquor plumbi acetici*), of each 4 grms.; rose-water, 250 grms.; and the yolk of one egg. This mixture is regularly in use (so the editor of this periodical states) by Creole ladies for beautifying their skin. A bottle containing this mixture in the above quantity is sold for about five shillings.

*Polytechnisches Journal von Dingler*, first number for June, 1870.

This number contains the following original papers relating to chemistry and collateral sciences:—

**Description of an improved Pair of Compasses for Drawing Very Minute Circles.**—M. Hellmann.—This description is accompanied by woodcuts.

**Description of an Improved Zundnadelgeweter.**—Dr. Dingler.

**Analysis of Normal Fire-Clays adapted to the Manufacture of Various Objects.**—Dr. C. Bischof.—This paper, which is, unfortunately too lengthy for any useful abstraction, contains, in the first place, a complete account of the methods of analysis of fire-clays, and the modes of testing these substances for their fire-resisting qualities. The author next details, at great length, a series of analyses of fire-clays, classified according to their value, beginning with a clay the resistance of which to fusion or softening is taken as =100, and ending with a clay which is only 10.

**Glue which Stands Moisture without Softening.**—Dr. Böttger.—Dissolve, in about 8 fluid ounces of strong methylated spirit,  $\frac{1}{2}$  an ounce of sandarac and mastic; next, add  $\frac{1}{2}$  an ounce of turpentine. This solution is then added to a hot, thick solution of glue to which isinglass has been added, and is next filtered, while hot, through cloth or a good sieve.

**German Beer Bouquet.**—Dr. Böttger.—This liquor consists of a solution of essential oil of lemons in light petroleum oil, and a coarse fusel oil containing spirit coloured by turmeric.

Second number for August, 1870.

This number contains the following original papers and memoirs relating to chemistry and allied sciences:—

**Vertical Oil-Gas Retorts.**—Dr. B. Hübner.—Illustrated with engravings.

**Apparatus for Heating the Air of Hot-Blast Furnaces.**—M. Whitwell.—Illustrated with a series of engravings.

**On Cast-Iron, Wrought-Iron, and Steel, in reference to the Construction of Engines and Machinery.**—Dr. Reiche.—This lengthy memoir treats on the physical, as well as chemical, properties of the materials alluded to, and on the defects they exhibit, due to the process of manufacture.

**Behaviour of Sulphuret of Zinc while Exposed to Air.**—A. Wagner.—The author records a series of experiments made with sulphuret of zinc, purposely prepared and left standing exposed to the air. The chief result of these experiments is, that sulphide of zinc hardly oxidises at all; and, for what little it does, it evolves sulphuretted hydrogen, and differs essentially from the sulphurets of iron and manganese, which become, under the same conditions, converted into oxides, sulphur being set free.

**Preparation of Hydro-Fluosilicic Acid on the Small Scale.**—F. Stolba.—The author describes, and illustrates with woodcuts, at great length and very minutely, the best method for the preparation of this reagent. The paper is too lengthy for useful abstraction.

**Application of Rock-Salt to the Manufacture of Glass; and on the Direct Preparation of Soda Silicates from that Salt and Silicic Acid, both from Native and Artificial Silicates.**—A. Ungerer.—Illustrated with a series of engravings.

**Nitrogenous Substances Present in Beer: a Contribution to Brewing.**—Dr. G. Feichtinger.—The author gives an exhaustive account of a series of experiments made with the view, not only to determine, quantitatively, the amount and nature of the nitrogenous matter present in beer, but also to show whence these nitrogenous compounds are derived, and the influence the various operations of the brewing process have upon the nature, as well as the quantity, of these substances. The chief result of these researches is that, a minimum excepted, the whole of the nitrogenous substances present in beer are derived from the albuminous matters present in the malt; and therefore the quantity of nitrogen found in the dry extract of beer may be calculated as albuminous matter.

**Manufacture of Beer from Rice.**—A. Belohnbeck.

**Explanation of Steam-Boiler Explosions.**—R. Wabner.—The author calls attention to the fact that hitherto no account has been taken of the possibility, which he proves to exist, that these explosions are occasioned sometimes by the formation of an explosive mixture of atmospheric air and the gases generated by the combustion of the fuel collected in the flues and tubes steam-boilers are provided with. The author gives instances of explosions which could be distinctly referred to this cause.

**Preservation of Thallium.**—Dr. Boettger.—The author states that, after having tried several methods, he has found that this readily-oxidisable metal is best kept unaltered by being kept in pure distilled water which has been boiled for a long time, to expel air, and cooled in a closed flask. An ingot of thallium fused under a layer of cyanide of potassium, and immersed in the liquid just mentioned, has preserved its silvery metallic surface unaltered for three years.

*Moniteur Scientifique*, No. 330, September 15, 1870.

The only original papers in this number relate to *brevets d'invention*, among which we notice the following:—

**Improvements in the Manufacture of Stearine (Stearic Acid).**—MM. Weiss and Co.—The process relates to a method of cooling of the oleic acid, obtained by the pressure of the stearine cakes, to a temperature of -5°. The acid, which always contains a certain proportion of stearine in solution, becomes, thus, a semi-fluid mass, which is



immediately transferred to a centrifugal machine lined with flannel, and kept cold by artificial means. The drum of this machine, having been set in motion (making 1200 to 1300 revolutions a minute), the oleic acid is separated from the stearine, and the latter recovered.

**Preservation of Grapes in the Fresh State.**—J. B. F. Tremellat.—The bunches of grapes are cut so that a good portion of the stem remains attached, and that portion is introduced into suitably-constructed glass vessels, which, by means of tubes, inter-communicate with a reservoir always filled with water. The stems of the bunches of grapes placed in this apparatus are kept in a properly-constructed room, neither too hot nor too cold; and, in this manner, the evaporation of water is prevented and the fruit kept fresh.

**Preparation of Organic Bases by Artificial Means, with the view to apply them to the Manufacture of Colouring Matters.**—C. Bardy and L. Dusart.—The authors state that, when the compounds of the polybasic acids with phenols act upon certain alkaloids, the result is the formation of a new series of alkaloids, which contain the original alkaloid in combination with the radical of the phenol which has been employed. For instance, when a mineral or organic sulphophenate acts upon aniline, diphenylamine is obtained—

$C_{12}H_5O.SO_3SO_3MO + C_{12}H_7N = C_{24}H_{11}N.SO_3.HO + SO_3.MO$ ; with a sulpho-phenate and naphthylamine, phenyl-naphthylamine is obtained; with sulpho-naphthalate and aniline, naphthylaniline. The authors give a lengthy description of the process they employ, which is chiefly confined to the operation of heating the various compounds under pressure at high temperatures.

**Manufacture of an Extract of Madder suitable for Dyeing and Printing Purposes.**—A. Rieu.—The author prefers to use, for his preparation, garancine, properly prepared and thoroughly stove-dried. This material is exhausted, in a properly-constructed apparatus, with boiling sulphide of carbon; the dry residue left after the evaporation of this liquid is treated with sulphide of carbon, in the cold, in order thereby to dissolve grease; after which, the colouring matter is left in the state of a semi-crystalline powder. This is converted into an aqueous paste, by being first dissolved in a very weak alkaline fluid, and precipitated by an acid from this solution, care being taken to avoid excess of acid. The flocculent precipitate thus obtained is washed by decantation, leaving an aqueous paste fit for direct use in the operations of dyeing and printing.

## NOTES AND QUERIES.

**Artificial Alizarine.**—(Reply to R. G. Bennett.)—Your only plan is to find out whether the process has been proceeded with, which you may learn at the Great Seal Patent Office; or you might experiment according to the directions given in the specification you allude to.

**Colouring Low-Priced Butters and Fats Yellow.**—(Reply to "Young Chemist.")—We certainly cannot undertake to assist you in committing an adulteration, which, *de facto*, amounts to neither more nor less than fraud. If the substance you named and tried, and which, as you are aware, is generally applied, does not answer your purpose, there is no other colouring matter which can be used with safety.

**Starch and Alcohol.**—I wish to know the correct composition and atomic weight to take for starch. On consulting various authorities, they all differ; 81, 96, 153, 162, 180, 198, &c., are given, with, of course, a variable constitution. At the same time, I want to know the true *theoretical* quantity of alcohol obtainable from 100 parts of starch, and how arrived at.—SCIOLIST.

**Extract of Indigo.**—I shall be glad if you or any of your readers will kindly tell me what substances are used for weighting extract of indigo (acid and neutral), so that it keeps its transparency when viewed through glass; also the greatest amount that can be got from, say, 1 lb. of indigo, and the best way of getting rid of that greenish tinge which some extracts have. I have no work that gives any information upon this subject.—INDIGO.

**Soap-Making.**—(Reply to J. Y.)—One of the best books on the subject you refer to is "A General Treatise on the Manufacture of Soap," by Professor H. Dussauce (Philadelphia: H. C. Baird; and London: Triibner and Co., 1869). This work may be inspected at the Library of the Commissioners of Patents. As regards the experiments made by Mr. Clift, it does not appear that they were ever made public, but perhaps Dr. Grace Calvert could give more information on this subject.

**A Good Suggestion.**—This may be among the first notes that you receive written on the new post cards, and I have to suggest their utility for the purposes of your "Notes and Queries" column; their use would ensure brevity, and, also, the writing must be on one side only. There is little fear of any ordinary person profiting by their contents during the process of transmission, as the language of modern science is so beautifully simple that chemists themselves are often puzzled to comprehend it.—JOHN NEWLANDS.

## TO CORRESPONDENTS.

**T. A. White.**—The method of using Woolfe's bottles is too well known to be described here.

**J. R.**—The latest German edition of "Fresenius" is referred to; the method of Lippert and Gintl is fully described in *Dingler's Polytechnisches Journal*, vol. cxc., p. 113, 1868, but there is not, as far as we are aware, an English translation of this paper.

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# THE CHEMICAL NEWS.

VOL. XXII. No. 568.

## ON THE ELECTRO-DEPOSITION OF COPPER AND BRASS.\*

By W. H. WALENN, F.C.S.

THE present condition of the electro-deposition of copper and brass is put forward, in this paper, with sufficient reference to the history of the subject to enable comparatively recent improvements to be well understood, but treating the process in a practical manner and with reference to some improvements and manipulations that are adopted by the author.

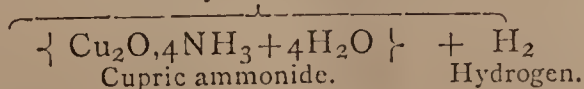
The history of electro-metallurgy, as set forth by Smee, in 1851, comprises only that part of the subject which relates to the electro-deposition of metals from their neutral or acid solutions. With some isolated exceptions, no alkaline solution is there treated of. He therefore arrives at the conclusions—(1) That if hydrogen gas is evolved from the cathode during deposition, non-reguline metal is deposited; (2) that up to 1851, alloys were not able to be deposited by means of electricity, but that possibly they might be deposited without the evolution of hydrogen gas, by employing an “intense voltaic current.”

To contrast with these views, it appears that, in 1851, there were from three to five practical methods of electro-depositing brass; and the present state of electro-deposition (independent of the improvements worked out by the author) shows that hydrogen gas is usually evolved from the cathode in copious bubbles during the deposition of reguline, but somewhat porous alloy from cyanide solutions, an intense voltaic arrangement being employed, in some respect to compensate for the waste of power induced by the evolved gas. The electrolysis of the solution of cyanide of copper in potassic cyanide also forms an exception to Smee's law for obtaining reguline metal, for during successful reguline deposition, hydrogen gas is evolved freely from this solution.

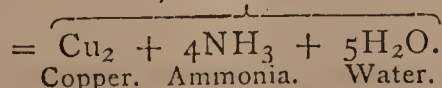
In alkaline solutions, the proneness to evolve hydrogen during deposition arises from the comparatively small quantity of metal in solution, and from the disposition of the metal of the alkali to go to the negative pole. The first cause can be removed by using a solution containing a greater percentage of metal than that usually employed; the second cause can be eradicated by providing, in excess, a decomposable compound radical that will take a certain amount of combined oxygen with it to the cathode.

Ordinarily, a solution containing the cyanides of copper and zinc, respectively, dissolved in a “solvent solution” consisting of a mixture of potassic cyanide with a salt of ammonium, is employed to deposit brass. This solution, however, evolves hydrogen copiously, and is only workable by means of two Grove's cells. The author finds that the evolution of gas may be either totally stopped, or much lessened, by dissolving as much of the metallic cyanides as the solution will take up, and then further charging the solution with the copper and zinc oxides. The evolution of gas may be totally stopped by the further addition of cupric ammonide, which may possibly carry the combined oxygen to the cathode according to the following equation:—

*At the cathode before chemical reaction.*



*At the cathode after chemical reaction.*



\* Abstract of a paper read before the British Association, Liverpool Meeting, Section B.

Malaguti and Sarzeau's formula for cupric ammonide being used. That is to say, before decomposition or chemical reaction takes place, the whole of the cupric ammonide, together with the eliminated hydrogen, goes to the cathode; after the decomposition or chemical reaction has taken place, metallic copper is deposited, ammonia is in solution, and water is formed.

In treating the ordinary cyanide copper solution for the prevention of the evolution of hydrogen, the zinc cyanides or oxides, mentioned in the instance of the brass solution, are left out.

When the evolution of hydrogen has been stopped, a single Smee's cell is sufficient to deposit the alloy; but, in practice, a single Grove's cell, or equivalent magneto-electric power, is employed, in order to shorten the time of immersion in the electro-coating bath.

The author prefers to use potassic cyanide and neutral ammonium tartrate, when mixed with water, to form the solvent solution for either brass or copper. The quality of brass (yellow or red) depends upon the heat of the solution.

Acid solutions, in general, give a spreading, or matted deposit; alkaline solutions, a bristling one. The contact of the coating is promoted by working the solution hot. The article should be pickled, scrubbed with sand, washed, scrubbed with a portion of the depositing solution, and then placed in the depositing trough; after deposition, the article is washed, and dried in hot mahogany sawdust. Complete protection from rust, and a satisfactory coating for any purpose, is given by the use of the acid-depositing bath subsequent to that of the alkaline bath.

The subject-matter of this paper is illustrated by a calico-printing roll, weighing 125 lbs., with 29 lbs. of deposit upon it; and by twenty other results of the inventor's improvements.

The coating by means of the author's method of working is superior to that of any other known process. The invention is set forth, in detail, in Specifications Nos. 1540 (A.D. 1857) and 3930 (A.D. 1868); and it is applicable to the prevention of rust, the coating of plungers and other portions of machinery, and the lining of cylinders, &c. It is also applicable to architectural and other castings, and to many purposes which require the strength of iron and the beauty of brass.

## ON THE PHENOMENA OF THE CRYSTALLISATION OF A DOUBLE SALT.\*

By J. BERGER SPENCE, F.C.S.

As an illustration of a double salt, we cannot have a more forcible example than the tribe of alums.

As a rule, it is generally supposed, with one exception, they are easily made and crystallised.

Seeing the supposed difficulty which seems to surround this one exception, I was led to make many experiments to ascertain where the real difficulty lay, and in the following pages are a few of the records of my experiments.

In the manufacture of alum it would be a great desideratum if the manufacturer could dispense with the expensive items of ammonia and potash, and substitute soda in the production of this double salt, because the ammonia and potash are of no value to the paper-maker or the dyer. If these constituents could be given to the agriculturists it would be a benefit to both parties.

My attention has for some time been directed to this question, and I have made a considerable number of experiments to ascertain whether soda-alum could be produced as easily and as economically as its sister salts. I believe little or nothing was known of this compound before the beginning of this century. The first mention I have seen of it is in Ure's “Dictionary,” where it says, “Mr. Winter first mentioned that another variety of alum

\* Read before the British Association, Liverpool Meeting, Section B



can be made with soda instead of potash, and that it is very difficult to crystallise." In Knapp's "Technology," the analysis of a natural soda-alum from South America is given. Watts's "Dictionary" says that it is found native in the island of Milo, in the Grecian Archipelago. Very few chemical works mention it fully, and most of the writers seem impressed with the idea that it is very difficult to crystallise. On this subject I have been experimenting for some months, and I find that the crystals can easily be produced if boiled down to the proper strength. The following are a few of my experiments:—

I prepared solutions of sulphate of alumina and sulphate of soda in their combining proportions to form alum. I boiled these solutions to 18°, 28°, 39°, and 47°, by Twaddle's hydrometer, and allowed them to stand for twenty-four hours; at the end of that time no crystals had made their appearance. In the case of ammonia-alum, a plentiful crop would have been obtained at 39° and 47°. It was not my object to make soda-alum from its equivalent salts, as that would be rather an unprofitable undertaking. These experiments were simply performed to find out the degree of crystallisation.

7000 grains of sulphate of alumina and 3360 sulphate of soda were dissolved and mixed; the solution was boiled down to 50°. It was standing for two days, and the yield of crystals was 150 grains. The cold solution was 65°; the mother-liquor was boiled to 67°. On cooling the solution, a white amorphous mass was formed (of this white mass I shall have to speak further on), which was re-dissolved and boiled down to 60°, and the yield of crystals was 4400 grains. The mother-liquor from the second crop was again boiled down to 60°, and the yield of crystals was 2390 grains. The total amount from the three crystallisations was 6940 grains.

The same quantities of salt were taken and boiled to 45°; 500 grains of strong sulphuric acid were added, which raised the strength to 52°; it stood for two days, and the yield of crystals was 260 grains. The mother-liquor was boiled down to 58°; the yield of crystals was 3700 grains, but these crystals did not look like pure alum, as they were more like sulphate of soda with crystals of alum interspersed. The solution was again boiled down to 60°; the crystals weighed 2200 grains. The total yield was 6160 grains.

A third experiment was made with the same quantity of salts, and the strength boiling was 55°. The yield was 2420 grains. The mother-liquor was boiled to 62°; the crystals weighed 3200 grains. The third crystallisation gave 1800 grains. The yield from the three was 7420.

Having now determined the crystallising-point, I proceeded to act upon shale which contained about 26 per cent of alumina. 1000 grains of calcined shale was treated with 400 grains of strong sulphuric acid boiled with water. 1000 grains of sulphate of soda was added, and the solution boiled down to 60°. The yield of crystals was 600 grains.

A second lot of shale, with three crystallisations, 1670.

The same quantity of shale, with sulphate of ammonia and one crystallisation, 3090 grains.

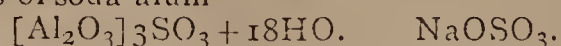
2000 grains of shale, and the equivalent quantity of acid and soda, were added; the solutions boiled to 74°. No crystals were formed, but instead, an amorphous mass. This was re-dissolved, and the strength was 71°; still this amorphous mass was formed. After three days, this magma was gradually transformed into crystals, and the yield was 1680 grains. The mother-liquor was boiled to 62°, stood for two days, and the crystals weighed 1210 grains. The mother-liquor in the third crystallisation yielded 450 grains. The total amount of crystals was 3340 grains.

The same experiment with shale and sulphate of ammonia and one crystallisation, 6180 grains.

My last and conclusive experiments were made upon soda and ammonia-alums, so that, by comparison, I should be enabled to judge whether sulphate of soda or sulphate of ammonia would be the most economical for forming alum. The atomic weight of the two salts was taken, and boiled to different degrees of specific gravity.

Twaddle's hydrometer was used, and the solutions were all allowed about the same time for crystallisation.

100 parts of a mixture of sulphate of alumina and sulphate of soda, in their atomic proportions, will form 113.3 parts of soda-alum—



100 parts of the mixed salts were boiled down to 30° to see how much alum would be formed, likewise to 40°, 50°, and so on.

Soda-Alum,  $\text{Al}_2\text{O}_3\text{SO}_3 + \text{NaOSO}_3 + 24\text{HO}$ .

	Deg.	Percentage of alum.
100 parts boiled to 30	gave	nil
" " 40	"	nil
" " 50	"	14.0
" " 60	"	33.6
" " 62	"	39.1
" " 64	"	47.6
" " 68	"	54.3
" " 72	"	61.8
" " 76	"	67.3
" " 80	"	68.3

Ammonia-Alum,  $\text{Al}_2\text{O}_3\text{SO}_3 + \text{NH}_4\text{OSO}_3 + 24\text{HO}$ .

100 parts of a mixture of sulphate of alumina and sulphate of ammonia, in their equivalent proportions, will form 113.5 of ammonia-alum.

	Deg.	Percentage of alum.
100 parts boiled to 30	gave	89.10
" " 40	"	91.50
" " 50	"	97.50
" " 60	"	101.26
" " 62	"	102.10
" " 64	"	103.00
" " 68	"	104.90
" " 72	"	106.10
" " 76	"	108.00
" " 80	"	111.80

When the alums are formed and are re-dissolved and re-crystallised the loss is very considerable in the case of soda-alum, as the following table will show.

A definite quantity of alum was dissolved in water, and boiled down as before to various specific gravities.

When soda-alum was boiled to 20° no crystals were formed, but in the case of ammonia-alum 80.15 per cent crystallised out.

*Percentage of Alum which Crystallised Out at Varying Specific Gravities.*—In most cases 4000 grains of the salts were taken: the solutions stood about twenty hours, but in the case of the soda-alums the solution stood a much longer time, as at 40°, 50°, and 60° not a crystal was formed at the end of twelve hours; the solutions were well stirred and then set aside for twenty-four hours.

Soda-Alum.

	Deg.	Percentage alum.
100 parts of crystals boiled to 20	.. ..	nil
" " 30	.. ..	nil
" " 40	.. ..	nil
" " 50	.. ..	29.70
" " 60	.. ..	34.92
" " 63	.. ..	59.57
" " 68	.. ..	72.72

Ammonia-Alum.

	Deg.	Percentage alum.
100 parts of crystals boiled to 20	.. ..	80.15
" " 30	.. ..	88.75
" " 40	.. ..	98.00
" " 50	.. ..	99.00
" " 60	.. ..	99.40
" " 63	.. ..	99.50
" " 68	.. ..	99.70

By these tables we see the very great disparity which exists, as regards the solubility of the two salts. At 68° soda-alum is more than 25 per cent behind ammonia-alum



at the same strength, and again it requires from three to four days for the crystals of soda-alum to form, whereas a few hours was sufficient for the ammonia salt.

In the first portion of this paper I have mentioned several times about a white amorphous mass which I always found on boiling the solutions of soda-alum to a high specific gravity. In my first experiments this annoyed me considerably, as I saw no way of overcoming the difficulty. Once when I boiled a solution of soda-alum to  $68^{\circ}$ , the customary white mass appeared on cooling. I put it on one side for a day or so, and on again examining it, I saw the surface was crystalline. I allowed it to stand for a few days longer, and day by day I watched it. The solution was put aside in a beaker so that I was enabled to watch the growth of the crystals. I was surprised to find at the end of the week that the whole of the white mass had disappeared, and in its place were large crystals of alum. It was most interesting to study the growth of the crystals as they grew from the top downwards, and according to the quantity of the amorphous mass so is the time for the crystals to form. I have examined this mass under the microscope with a quarter inch glass to see if I could detect any form; there was not the slightest crystalline appearance. The only explanation of this singular phenomenon which I can give is, that the alum is not really formed until the crystals appear, and time is requisite for them to unite and form the double salt; or again, may it not be that the high temperature to which the alum is exposed at the high specific gravity drives off the water of crystallisation, or some of it, thus giving an alum with minus its equivalent of water.

The important point was then to see the exact degree where the crystals merged into the amorphous condition and *vice versa*. For that experiment I used the mother liquors from the various crops of crystals.

The first portion was boiled to  $64^{\circ}$ : after twelve hours there was a crop of good crystals with a little of the amorphous mass mixed with the crystals.

At  $65^{\circ}$  a white mass with a honeycombed structure with crystals in the small holes.

At  $66^{\circ}$ , after twelve hours, half was a white mass, and the other half was crystals.

At  $67^{\circ}$ , after twelve hours, a white mass with very little signs of crystallisation about it.

At  $68^{\circ}$  the same as  $67^{\circ}$ .

The next point to determine was to ascertain how long it was before the white mass became converted into crystals. Here I found a variation extending from days to weeks, according to the strength of the solutions. The solution, which was boiled down to  $63^{\circ}$ , required three days for the crystals to form. One at  $68^{\circ}$ , a week. At  $74^{\circ}$  and  $76^{\circ}$  required three weeks, and another at  $84^{\circ}$  did not show any sign of crystallisation even at the end of three weeks, but was a white cake without mother liquor. On breaking the cake up, here and there crystals of alum were to be seen, bearing a faint resemblance to Fontainebleau sandstone.

From these experiments to obtain crystals we learn that the solutions should be at  $60^{\circ}$  at the boiling temperature, but they must not exceed  $62^{\circ}$ . Where time is of not much object the solutions may be boiled down to  $68^{\circ}$ , or even  $70^{\circ}$ .

On dissolving the crystals of soda-alum in water which is moderately hot, the white powder makes its appearance, and disappears in boiling. In this case, may it not be the sulphate of soda is dissolved first, leaving the sulphate of alumina to be dissolved afterwards. It will be seen that it is almost impracticable to make soda-alum on the large scale in competition with its sister compounds, when, in the first place, it is found that the solutions vary considerably in their crystallising power, for I have found sometimes that I could procure the crystals in two days, when at other times they have taken a week to form. Yet if the boiling solution is kept at  $62^{\circ}$ , a good crop may be reaped, though it would be much smaller than ammonia-

alum under the same circumstances. In the second place, the white amorphous mass which is formed in strong solutions would present considerable difficulties on the large scale, though, if time be given, ultimately the whole mass will be converted into crystals. Here, again, the time varies in the transformation of the amorphous to the crystalline condition. From the four experiments which I made on the mother liquors, boiling them to various specific gravities, the amorphous masses were several days in the transition state. In the case of another solution boiled to  $68^{\circ}$  it required six days for their complete conversion, and the higher the degree the longer is the time required for the change. I found if the masses were allowed to remain undisturbed the change was quicker than when they were disturbed with a rod.

In the third place, the excessive solubility of the salt is, I think, an insuperable difficulty; for if we turn back to the table of comparison, we find that when the soda-alum is re-crystallised and boiled down to  $63^{\circ}$  it takes three days for the crystals to form, and the percentage obtained is only 59.57, whereas, in the case of ammonia-alum, twenty-four hours are all that is required, and the percentage is 99.5.

The crystals of soda-alum differ a little in their form from the ordinary alums. The finest crystals are obtained from the amorphous mass, and these are octahedrons covered with minute triangles, as if the crystals were built up from the sides of pyramids.

There is certainly one advantage which the soda-alum possesses; that is, the cost of the sulphate of soda is trifling compared with sulphate of ammonia; and as the consumption of this latter material is gradually increasing, owing to its high value as a fertiliser, and as the agriculturist is now beginning to see the great value of these nitrogenous products, and as their value is lost in alum, it may ultimately, now that the practicability of producing soda-alum on the commercial scale has been demonstrated, even with all the difficulty of crystallisation, be a more economical way of producing this double salt.

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#### ON THE RETENTION OF ORGANIC NITROGEN BY CHARCOAL.\*

By EDWARD C. C. STANFORD, F.C.S.

TWELVE months' additional experience of the method of removing house excreta, which I introduced in a paper read before this Section last year, has fully confirmed all the advantages I then claimed for it. The use of X charcoal—that is, charcoal derived from the excreta itself—fully meets the only difficulties urged against the use of a dry system in large towns. The great power of the deodoriser employed reduces to a minimum the quantity required; and the source of supply is constant. Practically, once a year is quite often enough to empty the vault of an ordinary house; the amount to be removed is less than the house ashes, and the removal is even less offensive.

It has been applied to a large work and a number of private houses, and all who have inspected these acknowledge the arrangements to be a perfect solution of the difficulty. The process secures the whole value of the excreta, either to apply direct to the land, or in the form of sulphate of ammonia, and an animal charcoal second in value only to that derived from bones.

The only serious chemical objection that has been raised against the use of charcoal is, that its action upon organic nitrogenous matter is generally assumed to be that of a powerful oxidiser. Its powerful action on the carcase of an animal buried in it has led to the conclusion that the nitrogenous matter is oxidised into nitrates. It is, at any rate, a common opinion amongst chemists that charcoal

\* Read before the British Association, Liverpool Meeting, Section B



cannot be economically used in fish or flesh manures, because, in some way or other, the manure loses a good deal of its nitrogen. This opinion rests on insufficient evidence. The action of charcoal on organic nitrogenous matter has never, as far as I know, been the subject of definite investigation. Is there a loss of nitrogen, and if there is, what becomes of it? These are questions which at present cannot be decidedly answered.

Dr. Stenhouse, in a lecture delivered at the Royal Institution, in 1855, first brought the subject forward; he found appreciable quantities of nitric acid in wood charcoal which had covered the body of a dog for six months. But the actual results of mixing nitrogenous animal matters with different kinds of charcoal have never been thoroughly investigated. The subject is important; and I am induced to submit some incomplete researches, as a first instalment of what promises to be a wide field of inquiry. Its bearing on the profitable use of charcoal as a means of securing the whole value of town excreta is obvious. Any serious loss of nitrogen would invalidate the process.

I showed, last year, that, with either fluid or solid excreta, there was no loss, as far as my experiments had extended. I pointed out, also, that I expected no loss from oxidation, as both must already be regarded as oxidised compounds. My experiments since extend over a long period, and I have included meat as one of the nitrogenous matters used; in all, however, I find no loss of nitrogen, no oxidation, and no formation of nitrates. Three mixtures were made on March 1st, and left in loosely-covered dishes in the laboratory—

No. 1 consisted of  $\frac{1}{2}$  lb. of meat cut in fine pieces, and  $\frac{1}{2}$  lb. of seaweed charcoal from tangle.

No. 2.—10 lbs. of urine, and 1 lb. of seaweed charcoal, evaporated down to about 2 lbs.

No. 3.—2 lbs. of the ordinary produce of the dry closet used with charcoal, which contains about equal parts of mixed excreta and X charcoal.

The mixtures were not weighed again till May 7th, and then were weighed and tested monthly for nitrogen till September 7th. The following table shows the weights, in ounces, and percentage analyses:—

	MEAT.		URINE.		EXCRETA.	
	Weight.	Nitro- gen.	Weight.	Nitro- gen.	Weight.	Nitro- gen.
	ozs.	per cent.	ozs.	per cent.	ozs.	per cent.
May 7th ..	9.50	2.36	23.00	5.75	14.00	1.08
June 7th ..	9.25	2.14	22.75	5.52	13.75	1.06
July 7th ..	9.00	2.19	22.50	5.50	13.50	1.06
August 7th ..	8.75	2.22	22.25	5.62	13.25	1.10
September 7th	8.50	2.14	22.00	5.50	13.00	1.10

There was no loss of weight after May 7th, the differences in the table being the amounts taken for analysis. The nitrogen was estimated by combustion with soda-lime and precipitation with platinum; except in the case of the urine, where the proportion was large enough to estimate the ammonia by test-acid. Large samples were taken to ensure uniformity. The mixtures were all difficult to sample; and when this is considered, the variations in the analyses are within the limits of error. They conclusively show that for six months there was no loss of nitrogen; no trace of nitrates could be detected. I regret that I have no data between the time of mixing and May 7th, but I fully expected to see the nitrogen in the meat experiment gradually diminish, so as to compare it with the other two experiments, where I expected the nitrogen to remain constant. I have others in progress which will supply this omission. The nitrogens are, however, pretty near the theoretical quantities. At any rate, the experiments show that mixtures of various nitrogenous matter of animal origin remained mixed with seaweed charcoal and X charcoal in a perfect state of deodorisation, and freely exposed to the air without the formation of nitrates or loss of nitrogen; and this is all I wish to prove for the

present. I hope, in a subsequent paper, to show also the effect of wood and bone charcoal on meat, both dry and moistened with water, which will probably materially effect the result.

I choose these charcoals as the representatives of the opposite ends of the charcoal series—the former being nearly pure carbon, and the latter containing but little carbon comparatively. Seaweed charcoal and X charcoal have a composition about intermediate; as both, however, contain a good deal of carbonate of calcium, I would expect them to pre-dispose to the formation of nitrates.

Charcoal is the best medium for converting fish and flesh offal of all kinds into inoffensive manure, if the nitrogen can be retained; I expect to show that the fear of its loss is, to a great extent, unfounded.

## NOTE ON CLAUDET'S PROCESS FOR THE EXTRACTION OF SILVER.\*

By J. ARTHUR PHILLIPS.

It is well known to the chemical trade that a remarkable increase in the price of brimstone took place in the year 1838, when the King of Naples granted a monopoly of Sicilian sulphur to Messrs. Taix and Co., of Marseilles, and that the immediate result was the employment of iron pyrites, as a source of sulphur, in the manufacture of sulphuric acid.

The consumption of this mineral rapidly increased from that date, and for many years the supply was principally derived from the mines of Cornwall, and from those of Wicklow, in Ireland.

About the year 1853, pyrites, containing a small percentage of copper, began to be imported from Spain and Portugal, and considerable quantities of ordinary pyrites are now also derived from Norway.

The increased importance of this branch of industry will, however, be appreciated when it is stated that the annual consumption, in the United Kingdom, of pyrites for the manufacture of sulphuric acid is now about 350,000 tons, of which at least 250,000 tons contain a sufficient amount of copper to render its treatment for that metal commercially advantageous.

The principal mines from which the chemical trade is supplied with cupreous pyrites are those of Mr. James Mason, at San Domingos, in Portugal, and those of the Tharsis Sulphur and Copper Company, in Spain.

The ores from these localities do not differ very materially from each other, and the following analysis, of a specimen from Mr. Mason's mines, may be taken as representing an average sample:—

### Analysis of Mason's Pyrites.

Sulphur ..	48.90
Arsenic ..	0.47
Iron ..	43.55
Copper ..	3.10
Zinc ..	0.35
Lead ..	0.93
Lime ..	0.20
Insoluble rock ..	0.73
Moisture ..	0.70
Oxygen and loss ..	1.07

100.00†

In the manufacture of sulphuric acid this pyrites is burnt in kilns supplied with a limited amount of air, the products of combustion being from thence conducted into

\* Read before the British Association, Liverpool Meeting, Section B

† In addition to the above, this pyrites yields traces of thallium, cobalt, nickel, manganese, silver, and gold, and occasionally bismuth and antimony. See Mr. Claudet's analysis, *Journal of Chemical Society*, May, 1868.



lead chambers, as in the case of vitriol manufactured from ordinary brimstone.

The resulting residue, or "burnt ore," was formerly to a large extent smelted for copper, and from the great amounts of oxide of iron present, acted as a valuable flux for the more siliceous ores of that metal.

Burnt ore resulting from the treatment of pyrites from the San Domingos Mines may be taken as having the following percentage composition:—

*Analysis of Burnt Ore from the San Domingos Mines.*

Sulphur	.. .. .	3.66
Arsenic	.. .. .	0.25
Iron	.. .. .	58.25 = 83.00 Fe <sub>2</sub> O <sub>3</sub>
Copper	.. .. .	4.14
Zinc	.. .. .	0.37
Cobalt	.. .. .	traces
Lead	.. .. .	1.24
Lime	.. .. .	0.25
Insoluble matter	.. .. .	1.06
Moisture	.. .. .	3.85
Oxygen and loss	.. .. .	26.93

100.00

Silver 18 dwt. per ton.

Soluble in water = sulphate of copper 4.12 per cent = 1.65 Cu.

For several years past a large proportion of the burnt ore produced in the various chemical works of the country has been worked by what is known as "the wet process of extraction." The principal advantage of this method of treatment arises from the circumstance that the resulting "purple ore" or "blue billy" is a saleable product, and is largely employed, both in the blast-furnace and for "fettling" puddling furnaces.

By the process of liquid extraction at present usually employed, the burnt ore is first finely ground and sifted, and subsequently roasted with common salt until, by the oxidation of the metallic sulphides present, a portion of alkaline salt is converted into sulphate of soda, whilst the copper is, on the contrary, transformed into a soluble chloride.

The copper salt is subsequently removed by repeated washings, and the copper precipitated by iron in the metallic state, whilst the residual purple ore remains in the washing-vats.

It has been long known to those engaged in this business that the copper precipitate produced not only contains a notable quantity of silver but also distinct traces of gold. No attempt, however, to separate the precious metals, and to turn them to profitable account, had been made up to the commencement of the present year, when Mr. F. Claudet patented a process for the separation of silver from ordinary copper liquors by the addition of a soluble iodide.

The amount of silver present in burnt ore seldom exceeds 18 dwts. per ton; but as the whole of this is never obtained in solution, it follows that, dealing with such minute quantities, in order to obtain satisfactory commercial results, the process employed should be both cheap and expeditious.

The vats, in which the burnt ore which has been roasted with salt are lixiviated, generally receive some eight or nine successive washings, with either water or with water acidulated by hydrochloric acid, and of these the first three only contain a sufficient amount of silver to be worth working.

For the purpose of removing the soluble salts from the ground and washed ore, hot water is employed, and as a large proportion of the chloride of sodium used remains undecomposed, it acts as a solvent for the chloride of silver produced during the process of furnacing.

The analysis of the first washings from a copper tank gave the following results:—

*Analysis of Strong Liquors. Contents per gallon of 70,000 grains. Sp. gr. by hydrometer 1.240.*

	grs.
Sulphate of soda .. .. .	10,092
Chloride of sodium .. .. .	4,474
Chlorine (combined with metals)	4,630
Copper .. .. .	3,700*
Zinc .. .. .	480
Lead .. .. .	40
Iron .. .. .	32
Calcium .. .. .	52
Silver .. .. .	3.06

As, Sb, Bi, &c., not estimated.

Total Chlorine .. .. 7,347 = 12,106 NaCl.

„ Sulphuric acid .. 5,686 = 2,274 sulphur.

Proportion of copper to silver contained—

Copper .. .. .	10,000
Silver .. .. .	8.2

The respective amounts of copper, chlorine, sulphur, and silver contained per gallon in nine successive washings of one tank of ore are given in the following Table:—

*Copper Liquors from nine washings of one Tank of Ore.*

No. of washings.	Sp. gr.	No. of grains per gallon of 70,000 grains.			
		Copper.	Chlorine.	Sulphur.	Silver.
1st .. ..	1.285	5,230	10,798	1,324	4.06
2nd .. ..	1.250	4,600	9,079	1,455	3.25
3rd .. ..	1.175	1,935	3,215	1,881	1.05
4th .. ..	1.080	646	717	1,255	0.19
5th .. ..	1.095	666	643	1,436	0.12
6th .. ..	1.070	692	544	1,588	0.06
7th .. ..	1.060	342	217	938	0.03
8th .. ..	1.030	200	—	434	0.06
9th .. ..	1.020	117	—	294	0.04

Washings 1 and 2 contain 82.50 per cent of total silver.

„ 1, 2, and 3 contain 94.30 „ „ „

The several operations for the extraction of silver are conducted in the following manner; and as the first three washings contain nearly 95 per cent of the total amount of that metal dissolved, these alone are treated.

These liquors are first run into suitable wooden cisterns, each of a capacity of about 2700 gallons, where they are allowed to settle. The yield of silver per gallon is now ascertained by taking a measured quantity, to which are added hydrochloric acid, iodide of potassium, and a solution of acetate of lead. The precipitate thus obtained is thrown upon a filter, and, after being dried, is fused with a flux, consisting of a mixture of carbonate of soda, borax, and lampblack. The resulting argentiferous lead is passed to the cupel, and, from the weight of the button of silver obtained, the amount of that metal in a gallon of the liquor is estimated.

The liquor from the settling-vat is now allowed to flow into another of slightly larger capacity, whilst, at the same time, the exact amount of a soluble iodide, necessary to precipitate the silver present, is run into it from a graduated tank, together with a quantity of water equal to about one-tenth the volume of the copper liquor. During the filling of the second tank its contents are constantly stirred, and, when filled, a little lime-water is added, and it is allowed to settle during forty-eight hours.

The supernatant liquors are, after being assayed, run off, and the tank again filled, when the precipitate collected at the bottom is, about once a fortnight, washed into a vessel prepared for its reception.

This precipitate is chiefly composed of sulphate of lead, iodide of silver, and salts of copper, from which the latter are readily removed by washing with water acidulated by hydrochloric acid. Thus freed from salts of copper, the precipitate is decomposed by metallic zinc, which reduces the iodide of silver completely, and, to a certain extent,

\* 405 grs. of this copper exist in the state of subchloride.



also the sulphate of lead. The result of this decomposition is—

1st. Iodide of zinc, which, after being standardised, is employed in subsequent operations to precipitate further quantities of silver.

2nd. A precipitate rich in silver, and also containing a valuable amount of gold.

The more important constituents contained in a sample of this substance were estimated with the following results:—

*Moisture 25 per cent. Rough Analysis of Dried Sample.*

		oz.	dwt.	gr.
Silver .. ..	4.455 per cent	= 1455	6	0 per ton.
Gold .. ..	0.0595	= 19	8	12 „
Zinc .. ..	15.440			
Lead .. ..	56.400			
Copper .. ..	0.600			
Lime .. ..	1.100			
Iron .. ..	0.700			
Sulphuric acid	6.680			
Insoluble ..	7.600			

The results of nearly six months' experience of this process at the Widnes Metal Works show that  $\frac{1}{2}$  ounce of silver and  $1\frac{1}{2}$  grain of gold may be extracted from each ton of ore worked at a total cost, including labour, loss of iodide, &c., of 8d. per ton, or 1s. 4d. per oz. of silver produced. If from this amount be deducted 6d., the value of the 3 grs. of gold contained in each ounce of silver, the cost of production, per oz. of silver, will be reduced to 10d., and the expense of working a ton of ore to 5d. This leaves a profit of about 2s. on each ton of ore worked.

The value of the precious metals extracted from each ton of ore treated is certainly not large, as the amount originally contained is very small. With richer ores, however, more satisfactory results would be obtained; but when it is stated that some of the copper extraction works operate on 30,000 tons of ore annually, it becomes evident that a profit of 2s. per ton is a most important consideration in a business in which vigorous competition has rendered the exercise of the strictest care and economy absolutely necessary.

## ON THE ESTIMATION OF MANGANESE IN SPIEGELEISEN.

By J. SPEAR PARKER.

WHEN making determinations of manganese in spiegeleisens, I have frequently been struck by the fact that, when the solution is coloured blue by the presence of copper, that colouration invariably disappears after precipitation of the manganese as hydrated dioxide.

The method of analysis used is as follows:—The finely-divided spiegeleisen, after solution in hydrochloric acid, is peroxidised with potassium chlorate; the excess of chlorine boiled off, the solution diluted, brought to boiling, neutralised with ammonia, and the iron precipitated by addition of a boiling solution of ammonium acetate (feebly acid). After boiling for an hour, the precipitate is allowed to subside, then filtered and washed with boiling water. The residue is dissolved in hydrochloric acid, and the precipitation repeated. The two filtrates are concentrated to a small bulk by evaporation. When copper is present in appreciable amount, this solution has a distinct blue tint. If necessary, the solution is again filtered, carefully washed, the filtrate heated, slight excess of ammonia added, and bromine till the manganese is completely precipitated. After standing for twelve or eighteen hours, the precipitate is filtered; the filtrate is always colourless. The burning of the filter-paper, too, would generally communicate to the flame the peculiar green colour which is characteristic of compounds of copper.

A spiegeleisen usually contains 0.2 or 0.3 per cent of copper—sometimes 0.5, or even more; therefore the precipitation of the copper with the manganese would seriously impair the accuracy of the determination.

To place the matter beyond a doubt, the following experiments were tried:—The ignited proto-sesquioxide of manganese, obtained from 20 grains of a spiegeleisen containing copper, was dissolved in hydrochloric acid; the solution, which was of a bright green colour, was diluted and transferred to a weighed platinum crucible. A piece of pure zinc was added, and the crucible was almost immediately covered with a copper-red deposit. After complete precipitation of the copper, and solution of the zinc, the liquid was decanted, and the crucible washed several times with boiling water (allowing the particles to subside, and then decanting); finally, dried in the water-bath. The copper thus obtained weighed 0.07 gr.

A solution of manganous sulphate was then prepared, and two equal quantities measured by a pipette. The one after heating with ammonium acetate was precipitated by bromine; to the other, about a grain of crystallised cupric sulphate was added, and precipitation effected as before.

The proto-sesquioxide obtained from the first weighed 1.582 grs.; from the second, 1.823. The copper estimated in this gave 0.188 gr., equivalent to 0.235 gr. of cupric oxide. Subtracting this from the total weight of the second precipitate, leaves 1.588 grs.

By direct determination, manganese = 1.144 grs.

Precipitated with copper, which was subsequently determined and calculated to exist as CuO, manganese = 1.140 grs.

To ascertain how much copper it was possible to precipitate with the manganese, a solution containing cupric and manganous sulphates, in equal amount, was precipitated with bromine (keeping the solution as nearly as possible neutral).

The precipitate is of a lighter brown when containing copper than the pure hydrated dioxide. On igniting, it first changed to a fine black colour; after strong and protracted ignition, to brown black. After weighing, the copper was determined as before—

$Mn_3O_4(+CuO) = 2.98$  grs.

Copper = 0.70 „

This is equivalent to 0.88 gr. of CuO; subtracting from the first amount, leaves 2.10 grs. of  $Mn_3O_4$ , which contains 1.51 grs. of metallic manganese. There is, therefore, nearly 1 equivalent of copper to 2 of manganese. The copper can be extracted from the moist precipitate by boiling with strong solution of ammonia, or by digestion with cold dilute sulphuric acid (in the latter case, a small portion of manganese also is dissolved). It is probably present as a manganite of copper, corresponding to Mr. Weldon's acid manganite of calcium. This compound seems to be somewhat unstable; for if, during precipitation, the solution be allowed to become more strongly acid, or if, on the other hand, excess of ammonia be maintained throughout, the proportion of copper is considerably diminished, especially in the latter case.

Two methods may be used to remedy this error: either to separate the copper previous to the precipitation of the manganese; or to determine the amount of copper in the ignited oxide, and then subtract an equivalent amount of cupric oxide from the total weight of the precipitate.

In using the first method, 20 grains of the finely-divided spiegeleisen were completely dissolved in hydrochloric acid, diluted, and a current of sulphuretted hydrogen passed through the liquid. After standing for twelve hours, the solution was filtered and washed with water containing sulphuretted hydrogen; the filtrate was boiled, 10 grs. of potassium chlorate added, the iron separated, and the manganese estimated in the usual manner.

The following experiments were tried to test the accuracy of this method:—

(1). The manganese was estimated after separation of copper as above; gave 2.380 grs. of  $Mn_3O_4 = 8.57$  per cent of manganese.



(2). The manganese estimated as usual after separation of iron only, gave 2.457 grs. of  $Mn_3O_4 = 8.85$  per cent of manganese.

The copper was estimated in this precipitate by precipitation on a platinum crucible by zinc; gave 0.074 gr. of Cu = 0.093 gr. of CuO. Subtracting from the original weight, leaves 2.364 grs. of  $Mn_3O_4 = 8.52$  per cent of manganese.

Two experiments similarly conducted gave—

(1).  $Mn_3O_4 = 2.375$  grs. = 8.55 per cent of manganese.

(2).  $Mn_3O_4(+CuO) = 2.459$  grs. = 8.86 per cent of manganese. Cu = 0.077 gr., equivalent to 0.096 of CuO. Subtracting, leaves  $Mn_3O_4 = 2.363$  grs. = 8.51 per cent of manganese.

These results may be thus tabulated:—

Manganese by	1st expt.	2nd expt.
Usual method .. ..	8.85	8.86
After subtracting CuO ..	8.52	8.51
Previous separation of Cu..	8.57	8.55

In each of the experiments marked (1), a trace of copper escaped separation and could be detected in the ignited proto-sesquioxide.

If the method used be that of determining the copper in the precipitate, the estimation must be made with the greatest care, on account of the small quantity of copper present; the solution must be decanted immediately the zinc is completely dissolved, and excess of acid must be carefully avoided, otherwise the film of copper will partially re-dissolve.

It is evident that, if the precipitation be effected by ammonium sulphide or sodium carbonate, separation or estimation of the copper is likewise necessary.

Dr. Wolcott Gibbs proposed to precipitate manganese as ammonio-phosphate, weighing as pyrophosphate. This method gives very accurate results in pure solutions of manganese, but, in spite of every precaution, a minute amount of copper is dragged down with the precipitate in the presence of that element; it is also liable to the objection that calcium, magnesium, &c., when present, would also be precipitated.

The accurate determination of manganese in spiegel-eisen is of importance commercially; as, being the most important constituent, the value of the material is frequently judged by the percentage of that element alone, while the error introduced by the presence of copper is aggravated by the fact that, not only is copper worthless, but absolutely injurious.

The combining proportions used were—Mn, 55; Cu, 63.4; O, 16.

## ON ALUMINIUM WEIGHTS.

By Dr. T. L. PHIPSON, F.C.S.

For the last ten years—that is, since May, 1860—I have made use of a set of aluminium (division of the gramme) weights. On the average these weights have been used at least twice or three times a-day for a period of somewhat more than ten years. They were supplied by MM. Collot, Frères, of Paris. Latterly, I have tested them and found them as accurate as the day on which they were first used. They are almost as brilliant as when new. The larger weights 0.5, 0.2, and 0.1 gramme show slight traces of tarnish, but their weights are still quite accurate.

During this period of ten years these weights have never been touched except by a pair of soft brass nippers, and they have never been left exposed to the air for more than a few minutes at a time. However, they have, of course, been exposed for a minute or two at intervals to an atmosphere more or less impregnated with acid

or alkaline vapours, and if we add these odd minutes together, it will be found that these gramme divisions in aluminium have had to undergo a considerable amount of “atmospheric influence” during the period of which I speak.

I need scarcely say what a luxury it is to use such large weights as these in comparison to the platinum gramme divisions, and I am surprised that they are not more generally adopted in our laboratories. The set contains 14 weights, from  $\frac{1}{2}$  a gramme to  $\frac{1}{2}$  a milligramme. As to brass or copper divisions, I have always considered them inaccurate, for they tarnish very rapidly in an atmosphere which, for that of a laboratory, might be considered tolerably pure. Weights of malleable (a kind of German silver) resist much better than copper or brass weights; I have a set since the year 1856, the gramme divisions of which extend only to the centigramme, and are perfectly bright and accurate at the present day, but they have only been used occasionally.

The Cedars, Putney, S.W.  
October 10th, 1870.

## EXAMPLES FOR PRACTICE IN QUANTITATIVE CHEMICAL ANALYSIS.\*

By FRANK H. STORER,  
Professor in Massachusetts Institute of Technology.

(Continued from p. 163).

### EXPERIMENT V.—Determination of Lime in Marble.

REDUCE a quantity of pure white marble to fine powder and dry it upon a water bath. Weigh out 3 or 4 grms. of the powder, place it in a beaker of about 700 c.c. capacity, and pour upon it 40 or 50 c.c. of water. Cover the beaker with a glass plate and add dilute chlorhydric acid, little by little, to the water, until the whole of the marble has dissolved. About 100 c.c. of the acid may be required to effect the solution. As soon as the marble has dissolved, fill the beaker half-full of water and boil the mixture. Add a solution of oxalate of ammonium in slight excess, together with enough ammonia water to make the mixture alkaline. Leave the mixture at rest for twelve hours or more, then transfer the clear supernatant fluid to a six-inch filter, and wash the precipitate in the beaker, four or five times, by decantation. Finally, transfer the precipitate to the filter, and wash and dry in the usual way. Heat the precipitate in a porcelain crucible for fifteen minutes to a temperature just below redness, in order to convert the oxalate to carbonate of calcium. If the material analysed were absolutely pure, and the work entirely accurate, the final weight of carbonate of calcium obtained would of course be identical with the weight of marble taken.

Since it is difficult to convert oxalate of calcium to the condition of carbonate, by ignition, without decomposing a portion of the latter, it is well to moisten the ignited precipitate (after it has been cooled and weighed) with a solution of carbonate of ammonium, to dry the mixture, first upon a water bath, and then over the lamp at a gentle heat, and again weigh it. This last weight will give the true amount of carbonate of calcium.

In our experiment 3.101 grms. of marble were taken, and 3.0975 grms. of carbonate of calcium were found. 3.0975 grms. of  $CaO, CO_2$  represent 1.734 grms. of CaO. Hence we found 55.93 per cent of lime, instead of the 56.00 per cent required by theory.

Numerous forms of apparatus for determining the proportion of carbonic acid in limestone will be found figured in works relating to quantitative analysis.

(To be continued).

\* Communicated by the Author. From the *Massachusetts Teacher*.



## NOTICES OF BOOKS.

*The Natural History of Commerce, with a Copious List of Commercial Terms and their Synonyms in Several Languages.* By JOHN YEATS, LL.D., Fellow of the Geological Society of London; of the Royal Geographical Society; Member of the Society of Arts, &c. Assisted by several scientific gentlemen. London and New York: Cassell, Petter, and Galpin. 1870.

THE work before us, the first of a series, is one which we hope will be gladly welcomed and largely perused by those who must almost daily feel the want of a book of this nature. Undoubtedly there is a want of such books in the United Kingdom, and its merchants and manufacturers have reason to be indebted to the author, who in this volume delineates the principal divisions of the earth from an industrial point of view, and describes the varied contents of the inorganic and organic world—that is to say, the raw materials of commerce, according to their material value and importance. The book therefore comprises the geography and natural history of raw materials—the contents of that vast storehouse, the world at large, which ought to be familiar to all civilised men, and especially so to the mercantile classes of this country. The first part of the work contains—The Geography of the Home Country, the adjacent Continent, our Colonial Dependencies and Foreign Trade Connections. This first portion is subdivided into twelve chapters, viz.:—Raw Material; Our National Home; Geology of Great Britain; The United Kingdom—Ireland; The United Kingdom—Great Britain; British Fisheries; European Analogues of United Kingdom; the British Empire; British Colonies and Possessions; Foreign Produce—Europe; Asia; the New World; Nature and Man as Agents of Change. Part the second contains—The Commercial Products of the Vegetable Kingdom, subdivided into food plants, industrial, and medicinal plants. Part three—The Commercial Products of the Animal Kingdom, subdivided as follows:—Introduction; products of the class *Mammalia*; products of the class *Aves*; products of the class *Reptilia*; products of the class *Amphibia*; products of the class *Pisces*; products of the sub-kingdom *Mollusca*; products of the sub-kingdom *Annulosa*; products of the sub-kingdom *Radiata*; products of the sub-kingdom *Protozoa*. Part four—Raw Mineral Produce; subdivided into metals and minerals proper. The appendix contains—Vocabulary of the Names of Natural Productions in the principal European and Oriental Languages. Valuable as are the contents of the work, that value is largely increased by the addition of this excellent and very complete vocabulary, and for that alone the work should find a permanent place in mercantile offices among dictionaries of commerce and directories. Lastly, we have, illustrated by an excellent coloured frontispiece—The Geographical Distribution of Food and Industrial Plants.

It is a stigma to our days that works of this kind are not valued as they should be, while books of fiction and sentimental rubbish (partly the effect and partly the cause of an excitable nervous system) are read and bought with avidity. We therefore congratulate the author as well as the publishers for having the courage to undertake the issuing of such a work as this, which, moreover, has the merit of being written with brevity as well as accuracy, and is issued at a price which renders its acquisition by the many easy.

We have perused this volume with great pleasure; it supplies a want which those who are acquainted with the German and French works on what is characteristically called in German, "Waaren-Kunde," will best understand. This volume will be followed by two others from the same author's hand. The first, entitled "The Industrial and Political History of Commerce," will dwell upon the development and decay of the several nations that have successively taken a lead in arts rather than in arms; in it the uses and abuses of *Capital* will be chiefly con-

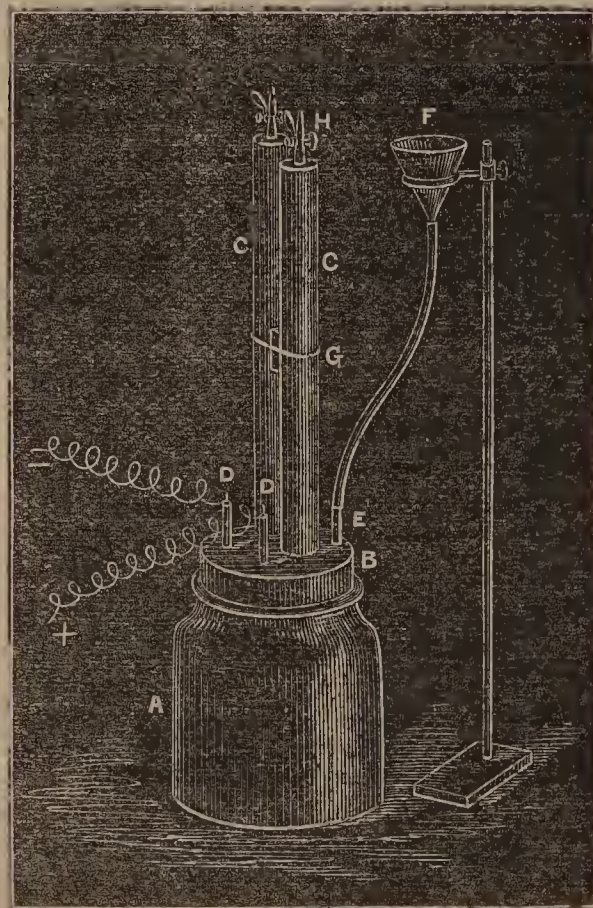
sidered, and the question submitted, Whether, notwithstanding serious lapses, mankind does not, as a whole, progress, and whether we may not speak of past ages as of wheat-ears, and say of them, they "ripen and die, yet live?" The third volume will have for its title, "The Technical History of Commerce," and will consist of a series of sketches on the growth of the industrial Arts, not of processes, which would lead into technology. It will deal with *Labour* principally, and the object is to show the heritage of wealth, both intellectual and material, enjoyed by the workman of the present day; it will contrast his position with that of any of his predecessors, and point out his duties to his fellow man as well as his obligations to posterity.

## LABORATORY NOTES.

## ON A CHEAP FORM OF VOLTAIC DECOMPOSITION APPARATUS.

THE decomposition tube, devised, I believe, by Dr. Hofmann, and described at p. 50 of his "Modern Chemistry," is an extremely elegant and luxurious piece of apparatus for showing analysis of bodies by electricity; but it has two defects, viz., that it is expensive to begin with, and very easily broken, either during its carriage, or by the mischances of the laboratory assistant. Experience of the fragile character of these tubes led me to make a more substantial apparatus, which, while it has the advantage of the ordinary tube, can be fitted up in any laboratory for a few shillings. The following is a description of the arrangement:—

A is a common pomade bottle, into which is fitted an india-rubber stopper, B, perforated with five holes (two



large, two small, and one medium size). Though the two large holes of the stopper pass two glass tubes, c c, of about  $\frac{1}{2}$ -inch diameter and 7 or 8 inches length. Each of these tubes is closed at the top by an india-rubber stopper carrying a piece of  $\frac{1}{4}$ -inch glass tube, to which is attached a jet and pinch-cock, H. The electrodes are made as follows:—A piece of thick platinum wire is beaten out at one end to form a flat plate, and is then threaded through a piece of glass tubing rather shorter than itself. When this is done, the glass is melted on to the platinum, and the tube, with its contained wire, is bent in the form of



the letter J. A second piece of wire and tube is treated similarly to form the second electrode. When these are made, they are passed through the two small holes of the stopper, B, and project above it, as represented at D D. The electrodes are turned so that they may pass up into the tubes, c c. To the remaining hole of the stopper is fitted a tube, E, connected by a piece of caoutchouc tubing with a funnel, F, supported on the ring of a retort stand. The apparatus is now complete, and when the stopper with its appendages is fitted into the pomade bottle, is all ready for charging. This is done by pouring the acidulated water or other electrolyte into the funnel, F, at the same time opening the pinch-cocks to allow the air to escape. When the bottle and tubes are full, the pinch-cocks are closed, and all is ready for attaching the battery to the electrodes at D D. I omitted to mention that the tubes, c c, may be conveniently steadied, should this be necessary, by tying them against a cork wedge, as represented at G.

C. J. WOODWARD, B.Sc.

Midland Institute, Birmingham,  
October, 1870.

## OBITUARY.

### AUGUSTUS MATTHIESSEN,

Who died last week, on the 6th of October, was born January 2nd, 1831, in London. He studied in Heidelberg, under Bunsen and Kirchhoff, and worked both in the chemical and physical laboratories.

His first piece of chemical work was published in the *Journal of the Chemical Society*, in the year 1856, under the title "On the Preparation of the Metals of the Alkalies and Alkaline Earths by Electrolysis." This research, a continuation of Bunsen's work on the subject, was carried out in Heidelberg, under Bunsen's inspection, and was crowned with success. The metals of the alkali-earths were then, for the first time, isolated and shown to be possessed of rather unexpected properties—calcium, for instance, being found to be a yellow metal particularly ductile and malleable, and having about the same degree of hardness as gold. It was shown that, although calcium is electro-negative to potassium and sodium (water being the exciting fluid), yet neither potassium nor sodium is capable of reducing chloride of calcium at high temperatures, and, therefore, that which had been described by other chemists as calcium obtained by such a process could not be the metal in question.

An extraordinary degree of manipulative skill was displayed in this investigation: and yet Matthiessen laboured under the physical difficulty of unsteadiness of hand (specially of the right hand), and in consequence of it wrote a most desperate kind of handwriting, as his friends can testify. He was, later in life, induced to give up writing with the right hand altogether, and to take to writing with the left.

Two other notices on the same subjects, viz.:—"On the Preparation of Strontium and Magnesium," and "On Barium," also occur in the same volume of the journal. An interesting fact brought to light in the former of these notices is that calcium is electro-positive to strontium (water being the exciting fluid). The note on barium, was to the effect that that metal could not be obtained as a regulus by the process which furnished buttons of calcium or strontium.

In the following year (1857), Kirchhoff communicated to *Poggendorff's Annalen*, a paper in Matthiessen's name, entitled "On the Electric Conductivity of Potassium, Sodium, Lithium, Magnesium, Calcium, and Strontium," and embodying the experimental results obtained by Matthiessen in the physical laboratory in Heidelberg.

From this paper it appears that, whilst Becquerel had

found the ratio of conductivity between potassium and silver to be 1.7 : 100, Matthiessen found it 22.6 : 100, both being observed at the same temperature, viz., 0° C. The device now so well known, of pressing out small portions of metal into thin wire by means of a steel press is also described in this paper. Matthiessen even managed to press out such substances as tellurium, bismuth, and antimony into thin wires, admirably adapted for physical determinations of various kinds.

*Poggendorff's Annalen* for 1858 contains two memoirs of Matthiessen's, viz., "On the Electric Conductivity of Metals," and "On the Thermo-Electric Series." In the *Philosophical Magazine* for the same year, Matthiessen had a paper "On the Coercitive Power of Pure Iron." About this time he returned to London, where he remained almost uninterruptedly till the end of his life.

In 1862 he was appointed to the chemical lectureship at the medical school of St. Mary's Hospital, and about the same period became a Fellow of the Royal Society. In 1869, he removed from St. Mary's to St. Bartholomew's Hospital, and, in the same year, the Royal Society awarded to him a Royal Medal, in acknowledgment of his researches. The physico-chemical work on metals, which, as has been said, was published in the years 1857 and 1858, was continued for a number of years, and published in a series of papers in the *Transactions of the Royal Society*.

Matthiessen also turned his attention to one of the departments of organic chemistry, viz., the chemistry of the opium-bases, which he investigated with conspicuous success. By exposing narcotine to the action of hydriodic acid, he and Mr. Foster obtained iodide of methyl in large quantities, and, as will be learnt on referring to their paper, actually attained to a knowledge of the structure of narcotine, which now awaits confirmation by synthetical methods.

The more recent work on morphia and codeia is fresh in the recollection of chemists. Some of it was done single-handed, and some with the co-operation of Mr. Wright. To medicine it has yielded apomorphia, a new agent in therapeutics. What further was in store is now withheld.

There is a fatality attending English official chemistry. Within the month one chemist has been stricken with acute mania, and next the epidemic seized upon poor Matthiessen, whom, in the dearth of English workers, we could so ill afford to lose. Overshadowed by a dark cloud, he poisoned himself with prussic acid.

J. A. W.

## CORRESPONDENCE.

### THE LATE DR. MILLER.

To the Editor of the Chemical News.

SIR,—May I suggest to yourself, and (through your kind intervention) to the scientific world, the desirability of honouring the memory of William Allen Miller, whose loss you feelingly communicate to your readers, by some permanent memento.

He had a diversity of claims upon our respect which render the combined action of his admirers more likely to effectuate good out of evil than happens in the case of every deceased philosopher.

A copious writer, an original observer, an experienced metropolitan lecturer, a conspicuous office-bearer in leading scientific societies, a graduate of London, Edinburgh, Cambridge, and Oxford, few men within the latter half of the 19th century have been better known (at least by name) to British students of nature, and fewer still equally valued for their personal amiabilities.

I would propose, therefore, with your favouring co-operation, and that of other leading English experimentalists, that we should raise, by subscription, a fund (to be vested in the Royal or Chemical Society, or in King's



College), the interest of which should annually be expended in gold or silver medals, or the like, to be openly awarded to youthful chemists who shall produce the best original memoirs on that branch of science dear to our deceased friend, the medals, in their style and impress, commemorating his worth as well as the investigator's merit.

I need hardly presume to say that to such a movement I should be glad to contribute my small quota of time and money, if emanating from any person more entitled to the consideration of chemists than—Your obedient servant,

B. W. GIBSON, B.Sc.

Eaton Square, S.W.  
October 10th, 1870.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

*Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

*The American Journal of Science and Arts*, September, 1870.

This number opens with the announcement that a third series of this periodical, originally started in 1818, will be commenced on the 1st of January next, and the issue will then become monthly. The following original papers and memoirs relate to physico-chemical and collateral sciences:—

**Atomic Volumes of Solid Compounds.**—F. Wigglesworth Clarke.—This lengthy memoir, full of cyphers and formulæ, winds up as follows:—Now to sum up the important relations traced in this paper, bearing in mind that, in many cases, exceptions exist—(1) When similar metals have equal atomic volumes, those of their similar compounds will also be equal; (2) metals whose atomic volumes are unequal, but simply related to one another, often form similar compounds having equal values; (3) some compounds have atomic volumes which stand in very simple relations to the sums of those of the free elements which form them; (4) compounds formed by the union of similar elements have atomic volumes which are multiples of the lowest for that group; (5) we may add the multiple relations traced in my former papers, which not only connect the atomic volumes of different elements but the various values for each single element. May we not say, the author proceeds, that, in all compounds, the atomic volume of every element will be either a perfect multiple of the lowest value for that element, or of the lowest value in the group to which it belongs? Although this theory cannot be regarded as entirely proved, it certainly possesses a considerable degree of probability, and seems to harmonise well with the regularities which I have pointed out; but why an element should have a higher value in one compound than in another remains to be accounted for, although upon this point, perhaps, Dr. Buff's idea, that the different degrees of quantivalence of an element in its various compounds cause the difference in its atomic volumes, may prove correct. But, at all events, whether the theory I put forward turns out true or false, it may, perhaps, by lending some system to the study of atomic volume, pave the way for something of greater value.

**Researches in Electro-Magnetism.**—Dr. A. M. Mayer.—This lengthy memoir, illustrated by a series of woodcuts, contains an exhaustive account of a series of more than thirty experiments, made with the view to ascertain the relative forces of two electro-magnetic cores—one composed of *insulated* wires; the other, of the same number of similar wires, *uninsulated*.

**Precipitation and Determination of the Metals of the Magnesium Group in the form of Oxalates.**—W. Gould Leison.—Reserved for reproduction in full.

**New Analytical Process.**—J. H. Talbott.—The process alluded to is the precipitation of zinc from a neutral, or nearly neutral, solution, by the addition of sodic or ammoniac sulphide to the boiling zinc-containing solution. An excess of the precipitant is to be avoided; a white granular sulphide of zinc settles rapidly down, and is washed with hot water by Bunsen's method. The sulphide of zinc is partially dried with the filter, brought into a porcelain crucible, and ignited, at first gently, and afterwards strongly, with free access of air. The expulsion of the last traces of sulphuric acid is facilitated by the addition of small fragments of carbonate of ammonia; pure oxide of zinc at last remains. The author states that this method of quantitative estimation of zinc is very correct; manganese may be estimated by a similar process.

**Quantitative Separation of Tin and Tungsten.**—J. H. Talbott.—The method described by the author is based on the fact that stannic

oxide,  $\text{SnO}_2$ , is reduced by potassic cyanide with great facility; while tungstic acid,  $\text{WO}_3$ , undergoes no reduction, even when heated with the cyanide at a high temperature. The oxides of tin and tungsten are to be heated in a porcelain crucible with three or four times their weight of commercial potassic cyanide, previously fused, pulverised, and thoroughly mixed with the two oxides. The mass is kept fused for a short time, when the tin separates in the form of metallic globules, while the tungstic acid unites with the alkali of the potassic cyanate and carbonate present. After cooling, the mass is to be treated with hot water, which dissolves the alkaline tungstate and other salts, and leaves the tin as metal; this is to be separated by filtration, washed, dried, and weighed as stannic oxide, after oxidation in the crucible with nitric acid. The tungstic acid may be estimated by difference, or be precipitated by mercurous nitrate after boiling the solution with nitric acid, to decompose the excess of potassic cyanide present, and then re-dissolving the precipitated tungstic acid by means of an alkali. The author quotes some examples of experiments made by him with this method, from which it appears to be very correct. Tin cannot be separated from molybdenum by this process, because molybdic acid is always more or less reduced to a lower oxide.

**Treatment of Gelatinous Precipitates.**—T. M. Chatard.—After referring to the inconvenience and loss of time familiar to all chemists which attend the washing of all gelatinous precipitates, the author suggests that the solution containing the substances to be determined is to be simply evaporated to perfect dryness (best on a water-bath) with a small excess of the precipitant, and the gelatinous mass stirred with a rod, until it becomes a perfectly dry powder. The author communicates the results of some experiments made by him according to this plan, from which it appears that the accuracy of the analytical results rather gains than loses by this method.

**Precipitation of Antimonous Sulphide from Boiling Solutions.**—S. P. Sharples.—In order to obtain the precipitate of antimonous sulphide in a granular state, the author employs the following process:—Into the solution containing, as usual, tartaric and free hydrochloric acids, a current of sulphydric acid gas is to be passed; the liquid being, during the passage of the gas, gradually heated to the boiling-point. The boiling is to be continued for fifteen or twenty minutes, the current of the gas passing, uninterruptedly, until the voluminous sulphide has become a dense granular powder occupying but a small portion of the original volume of the sulphide. The precipitate thus obtained may be washed with great facility, and dried at  $200^\circ$ – $300^\circ$ . Arsenous sulphide does not become granular and dense under the same conditions. The author incidentally observes that the sulphides of nickel and cobalt, when thrown down from boiling solutions, should be filtered off and washed immediately after precipitation; in this manner, there is no oxidation upon the filter, even during the drying of the precipitate.

**Introduction of the Principle of Repetition into Chemical Analysis.**—Bryant Godwin.—What the author desires should be done is best elucidated by the instance quoted by him at some length—When iron is determined by means of potassic permanganate, all the iron is, at the end of the operation, in the form of sesquioxide, while there is also a very small excess of unreduced permanganate. When the solution is boiled for a short time with pure zinc-dust, and rapidly filtered and washed with water (previously boiled to expel air), the iron is left as ferrous oxide, and the process of titration may be repeated a second, and even many more times, until the bulk of the liquid becomes too large to handle. The author quotes the results of a series of analyses made in this way; which serve to show that, with more practice and experience, the principle at least holds good, since, in one case, five repeated titrations gave 14.31 per cent of iron; and, in another case, seven successive titrations gave 14.23 per cent, while the formula required 14.27 per cent.

**Pure Scarlet.**—W. H. Dall.—The author, in a letter to Professor Silliman, states that, in 1863, while engaged in making anatomical drawings from living microscopic animals, he purchased, among other colours (water colours), a cake (made by Winsor and Newton, of England) stamped "pure scarlet"; it was, indeed, the finest and most vivid scarlet—far superior in brilliancy to any of the various shades of vermilion which are commonly sold. The author further states that he had no occasion to use the colour until 1865, and, later, in 1866 and 1869. The objects coloured with this colour were found to fade very rapidly; and, in one instance, a valuable drawing was lost by the complete fading of this colour, which had been applied for scientific purposes. On examination of the substance; it (the cake of colour) was found to be soluble in iodide of ammonium and hyposulphite of soda; and, with nitrate of silver solution, iodide of silver was produced. The author supposed that the colour was acted upon by hyposulphite of soda, present in the paper; but this supposition is doubtful, considering that three kinds of paper (one of them made expressly for water-colour drawing) gave the same result. Professor Silliman states, in a foot-note, that he tested the small sample of colour sent him, and found it to be *mercuric iodide*, well known to chemists as very volatile, changing, at a gentle heat, from scarlet to nearly white, and the latter returning again to scarlet by friction. Since this exceedingly attractive pigment is liable to be used by naturalists in valuable drawings, it may not be out of place to call their attention to its ephemeral properties.

*Bulletin Mensuel de la Société Chimique de Paris* (double number) September and October, 1870.

From the *procès verbaux* of the two latest meetings held by this Society, we quote the following particulars:—

**Researches on Albumen.**—Dr. Gautier.—The albumen present in the so-called white of eggs consists of two different modifications of that substance; one of these bodies is coagulated at  $63^\circ$ , the other at

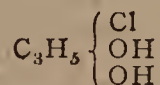


74°; they are present in the white of eggs in the proportion of 1 to 5. The rotatory power of the first is 43'20"; that of the second, about 26". White of eggs contains, moreover, a caseine-like matter, and lacto-proteine. When white of eggs is treated with water at 15° (that is to say, is kept under water) for six months, in such a manner as to prevent its putrefaction, it becomes partly incoagulable, while the products formed by this reaction differ from those which are formed at 150°, since the pure albumens obtained by dialysis yield, at that temperature, a soluble and insoluble portion, containing—(1) A substance resembling caseine; (2) a substance precipitable by acetate of copper, and analogous to hypoxanthine; (3) a residue partly soluble in alcohol, which, by the aid of corrosive sublimate and basic acetate of lead, are split up into various other albumenoid bodies.

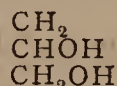
**Phospho-Platinic Compounds.**—Dr. P. Schützenberger.—When the compound  $\text{PtCl}_2 \cdot \text{PtCl}_4$  is treated with alcohol, there is formed  $\text{P}(\text{C}_2\text{H}_5\text{O})_3\text{PtCl}_2$ , a crystalline body soluble in alcohol and in dilute hydrochloric acid. This substance plays the part of a diatomic radical, the trioxethyl-phosphoplatine. The different salts of this radical are obtained by means of double decomposition between a silver-salt and the alcoholic solution of the chloride. Baryta converts this chloride into a black compound, which is the hydrate of the radical, which latter is obtained in the shape of a black viscous mass, by the action of zinc upon the alcoholic solution of the chloride. The radical combines with chlorine directly, the result being the reproduction of the chloride. The chloride of trioxamyl-phospho-platine is obtained as the chloride just alluded to, simply by replacing the hydride of amyl for alcohol. The compound  $\text{P}_2\text{Cl}_6\text{PtCl}_2$ , formed by the action of  $\text{PtCl}_2$  upon  $\text{PtCl}_2 \cdot \text{PtCl}_4$  yields, with water and with alcohol, hexatomic derivatives.

**Chlorhydride of Cyanogen.**—Dr. A. Henniger.—The speaker stated, in reference to the fact that MM. Naumann and E. Vogt have proved, recently, that the compound  $2\text{C}_2\text{H}_5\text{Cl}$ , discovered and described by Dr. A. Wurtz, does not exist as a separate and definite chemical body, has been long since known to Dr. Wurtz; and, as a proof thereof, is quoted a phrase from the "Dictionnaire de Chimie Pure et Appliquée," vol. i., p. 1080, where it reads—"Dr. Wurtz had called chlorhydride of cyanogen a product which he now considers as a mixture, or, at most, an unstable compound of chloride of cyanogen and hydrocyanic acid."

**Action of Silver upon Monochlorhydrine.**—Dr. Silva states—When monochlorhydrine—



is acted upon by very finely-divided metallic silver at 180°, with the view of withdrawing the chlorine, and also to see whether two molecules of the mono-atomic residue—



will combine to form erythrite, the reaction appears to be such as theory would lead to expect.

**Solubility of Oxygen in Molten Silver.**—Dr. P. Schützenberger says that he and M. Grange are engaged in making experiments on the solubility of oxygen in molten silver; and he gave a *viva voce* description (not quoted in print) of the apparatus employed.

This number contains, further, the following original papers:—

**Preliminary Communication on the Fatty Matters contained in Chyle.**—Dr. Dobrowskine.—This portion of the author's labours is devoted to a chemical investigation of the fatty substances present in the chyle taken from the *ductus thoracicus* of cows while the digestion of these animals was in full activity. The chyle, having been dried, was exhausted with ether, by the evaporation of which there was left a brownish-coloured, solid, partly crystalline mass, soluble in warm ether and in boiling alcohol at 95 per cent. The purified fat was found to contain, in 100 parts—Carbon, 75.36; hydrogen, 12.36. When this fatty matter was saponified, by means of an alcoholic solution of caustic potassa, some ammonia was given off. The purified fatty acid was found to yield, on elementary analysis, in 100 parts—Carbon, 75.98; hydrogen, 12.93. Formula,  $\text{C}_{18}\text{H}_{36}\text{O}_2$ . The author states that, judging from the irregularity of the point of fusion and consolidation, this fatty acid is a mixture of 60 per cent stearic, and 40 per cent palmitic acid. Chyle also contains some oleine.

**Spectroscopic Reactions of Sulphur; and on the Flame of Hydrogen.**—G. Salet.—In this paper, the continuation of a lengthy memoir on this subject, the author describes some peculiarities of the blue flame of sulphur and some of its compounds. This blue flame is not hotter than red-hot iron, and contains reduced sulphur; but, at the periphery of the flame, very active oxidation takes place, and sulphuric acid is formed. The author describes, at length, an arrangement to prove this fact; and this same arrangement is suitable to prove, by experiment, that the zone of aqueous vapour which envelops the flame of burning hydrogen, contains nitric acid and deutoxide of hydrogen.

*Annalen der Physik und Chemie, von Poggendorff, No. 7, 1870.*

This number contains the following original papers and memoirs:—

**Change which Radiation of Heat Undergoes by the Roughness of the Surface of Bodies.**—G. Magnus.—Illustrated by several engravings.

**Specific Gravity of Alcohol and of Mixtures of Alcohol and Water.**—Dr. E. H. von Baumhauer.—The contents of this paper are

essentially the same as those of the same author's paper quoted in CHEMICAL NEWS, vol. xxii., p. 71.

**Passage of Mercury through Glass Capillary Tubes.**—E. Warburg.—An algebraico-physical essay, illustrated with woodcuts.

**Continued Researches on Liquid Conductors of Electric Currents.**—J. W. Müller.—The last instalment of a very exhaustive and lengthy memoir.

**Estimation of the Fusion and Solidification Point of Fats and other Substances.**—F. Rüchhoff.—The main point of interest in this paper is that the author proposes that, instead of taking the fusion-point of such substances as fats, fatty acids, wax, paraffin, and the like, it is preferable to determine accurately the point of solidification of these substances, since that point can be determined with far greater accuracy than the fusing-point.

**Electromotive Force Developed by the Contact of Divers Metals.**—E. Edlund.

**Researches on the Properties of the Images Produced by Photographic Lenses.**—Dr. H. Vogel.—Illustrated with a series of engravings.

**Velocity of Light while Passing through Quartz.**—V. Lang.

**Specific Heat of Saline Solutions and Mixtures of Liquids.**—A. Wüllner.

**Melting of Lead-Shot Fired against an Iron Target.**—E. Hagenbach.—Illustrated with diagrams.

**Experiment on the Simultaneous Boiling of Two Liquids which are not Miscible.**—A. Kundt.—The chief point of interest in this paper, wherein the author gives an account of a series of experiments made with water and benzol, water and oil of cloves, water and sulphide of carbon, is, that two liquids, not miscible with each other when in contact, boil at a lower temperature than when the most volatile of these liquids is brought to ebullition by itself.

**Microscopically-Small Tridymite.**—F. Zirkel.

**Acoustical Attraction and Repulsion.**—K. H. Schellbach.

*Polytechnisches Journal von Dingler*, first number for September, 1870.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

**Experiments to Determine the Value of Various Kinds of Oils Used for Machinery.**—H. Fischer.—This paper, chiefly filled with tabulated results of experiments, contains the record of trials of various kinds of oils used for the greasing of machinery, in order to determine their fitness.

**Manufacture of Coke from Non-Caking Coals.**—E. Vériot and T. Appolt.

**Contribution to the History and Statistics of the Manufacture of Mineral Oils, Paraffin, and the Distillation of Brown Coals in Saxony.**—R. Jacobi.—The contents of this paper, chiefly of local interest, contain a series of tabulated forms, from which it appears that the industry alluded to is very extensive.

**Description of a Process by means of which all Printed Matter, Printed Plates, and Lead-Pencil Drawings may be Readily and Rapidly Copied without any Detriment to the Original.**—C. Puscher.—This paper, too lengthy for any useful abstraction, contains the description of a process, and the receipts for making the required preparations, by means of which the object above quoted may be effected; but, judging from the description given, the process is rather a complicated affair.

**Extract of Madder for Use in Calico-Printing.**—P. Schützenberger.—After referring to the history of the preparation and application of extracts of madder, the author chiefly treats on the use of alizarine direct and without any mordant. This alizarine is that which is obtained from so-called green alizarine (prepared from madder-root), by means of petroleum. The success of the direct application of alizarine depends, first, upon the use of a very pure extract of madder; next upon the use of pure acetate of alumina and a proper solvent for the colouring matter, usually strong acetic acid; and, lastly, upon the simultaneous application of certain substances—preparations of tin, fatty acids, certain salts of lime—all of which serve partly to give a certain hygroscopic action, and also to modify the shade of the colour. Pure alizarine yields a brilliant violet, but it has a reddish hue. Unless purpurine is simultaneously present, alizarine does not yield a good red.

**Practical Value of the Continuously-Acting Diffusion Apparatus in Beet-Root Sugar Works.**—Dr. O. Cech.

**New Method for Analysing Milk.**—R. Pribram.—This lengthy memoir is illustrated with woodcuts absolutely required to render the contents of the paper understood.

**Preparation to render Lead-Pencil Drawings, Tracings, and Writing, and also Charcoal and Chalk Drawings, Fixed.**—W. Wolanek.—The author states, that when the paper containing drawings or writings made with lead pencil or charcoal is painted over, on the reverse side (where no writing or drawing exists) with a moderately-strong solution of bleached shellac in alcohol, the drawings or writings made with lead pencil, &c., become thoroughly fixed, so that they cannot be rubbed off.

**Poisoning by Dyeing Aniline Black.**—A. Dollfus.—The author states that, while two of his workmen were engaged in dyeing cotton yarn in a hot mixture consisting of aniline, hydrochloric and tartaric acids, sulphuret of copper, chlorate of potassa and water, the men



were suddenly seized with severe headache, difficult respiration, tremor and languor, becoming cold and very weak. Properly administered medical aid restored them to health; but the author cannot well account for these symptoms but by assuming them to be due to the volatilisation of some chloride of arsenic, which may have been formed in consequence of some arsenic having been left in the aniline by careless manufacture; unless, indeed, the symptoms are due to the action of the vapours of aniline itself.

*Journal für Praktische Chemie*, No. 14, 1870.

This number contains the following original papers and memoirs:—

**Some New Sulpho-Salts.**—R. Schneider.—This paper, the concluding portion of this very lengthy and exhaustive monograph, contains the following chapters:—Sodium platinum-sulpho platinate—

$\text{Na}_2\text{S}, \text{Pt}''\text{S}, \text{Pt}''\text{S}, \text{Pt}''\text{S} \cdot \frac{1}{2} \text{Pt}'''\text{S}_2$ ;  
potassium platinum-sulpho stannate; sodium platin-sulpho stannate; disodium platin-sulpho platinate; silver platinum-sulpho platinate; thallium platinum-sulpho platinate; copper platinum-sulpho platinate; plumboplatinum-sulpho platinate; mercurio platinum-sulpho platinate, with bichloride of mercury; sulpho potassium-sulpho thallium. Of all these salts, the mode of preparation, composition per cent, and formulæ are given.

**Condition of Chemistry in France.**—Prof. H. Kolbe.

**On Acridine.**—C. Græbe and H. Caro.—The authors discovered, while engaged in purifying crude anthracen, a new substance, which, on account of its biting action when brought into contact with the skin, they have called acridine, a colourless crystalline body, fusing at  $107^\circ$ ; can be heated to  $360^\circ$  without decomposition; boiling at that temperature; hardly soluble in cold, but more readily so in hot water; very readily soluble in alcohol and ether. Acridine,  $\text{C}_{13}\text{H}_9\text{N}$ , is a strong basic body, uniting with acids to form salts which, like the base itself, are very biting and acrid substances.

**On Pyren.**—C. Græbe.—The substance just named has been found, by the author, among products containing anthracen. Pyren is a solid, crystalline substance, fusing at  $142^\circ$ , readily soluble in boiling alcohol, in benzol, ether, and sulphide of carbon. This body combines with picric acid, forming a peculiarly characteristic red-coloured crystalline compound,  $\text{C}_6\text{H}_{10} + \text{C}_6\text{H}_2(\text{NO}_2)_3\text{OH}$ . Pyren is also characterised by forming, very readily, various substitution compounds, several of which are described in this paper.

*Neues Jahrbuch für Pharmacie*, von Dr. F. Vorwerk, August, 1870.

The July number of this periodical not having yet arrived, will be quoted afterwards. This number contains the following original papers:—

**Stassfurth and its Industry.**—J. Wolff.—The town of Stassfurth is situated in Prussia, Regierungsbezirk (County) of Magdeburg. This lengthy paper gives a detailed account of the enormously-extensive beds of salt wrought near and under the town alluded to since the year 1852. The material, known as *Abraum salze* (there is no proper equivalent English word for this substantive, the nearest approach being *residual salts*), contains a mixture of carnallite (chiefly a compound of the joint chlorides of potassium and magnesium with water, and is worked for potassa, since it may contain up to 26.8 per cent of chloride of potassium), kieserite, polyhalite, and, more rarely, tachhydrite, kainite, and sylvine. A new mineral, called Stassfurtite, or boracite, has also been met with; its composition is expressed by  $2(3\text{MgO} \cdot 4\text{BO}_3) + \text{MgCl} + \text{HO}$ . Among the products of this district, bromine is one of the chief chemical substances, now manufactured by Dr. Frank to a quantity of from 120 to 150 lbs. per day. The bromine is obtained from the residual mother liquors.

**Production of Opium from the Papaver Plants Cultivated in Germany.**—E. Schwend.—This paper contains the author's account of a series of practical experiments instituted on a sufficiently large scale. The result is, that 1 hectare of land yields 10 lbs. of opium, and, moreover, 15 cwts. of poppy seed, from which a fatty oil is obtainable. Nothing is stated in reference to the value of this opium—viz., the quantity of morphia contained in it.

**Contribution to the History of some of the Alkaloids.**—Dr. Th. Husemann.—This first portion of a lengthy monograph treats on the aconite alkaloids, but the subject is chiefly considered pharmacodynamically and toxicologically.

*Revue Hebdomadaire de Chimie*, September 8, 1870.

Whilst this number has come to hand, several others, published before this date, have not arrived; and most of the other French periodicals are wanting. This may be readily accounted for by the events of the day.

**Treatment of Wood in order to make it a Suitable Material for Paper Manufacture.**—M. Mène.—The wood, previously reduced to the state of shavings or sawdust, is placed for a time (the duration of which depends upon the nature and state of division of the wood) into water, being left there to rest, as is done with flax. By this treatment, a great many substances are removed from the wood, which is thereby afterwards more readily pulped. The rotting in water has the effect of disintegrating and partly decomposing the nitrogenous and incrusting matter of the wood, which is also afterwards more readily bleached, not becoming yellow by the use of chlorine, as is the case where these matters have been left in the wood. The rotted wood is, previously to any other treatment, thoroughly washed with boiling water and steamed, and next treated with an alkali.

## NOTES AND QUERIES.

**Carbonic Ether.**—I wish to purchase a small quantity of carbonic ether. I have tried most of the houses in London, but without success, and should feel obliged if you could direct me where it is to be obtained.—H. S.

**Manufacture of Sulphuric Acid.**—Can any of your readers inform the writer what is meant by a new process for economising nitrate of soda in the manufacture of sulphuric acid, called the "oxygenised," or "oxygenising" process?—A MANUFACTURER.

**Bleaching Wax.**—Will you kindly inform me—(1) The easiest method of bleaching paraffin-wax and bees'-wax, and rendering it transparent. (2) What chemical is used in the transaction, and, likewise, the quantity required to bleach, &c., 1 cwt., and the cost of the same? I have a friend, and he says he can do it in one hour, and render it white and transparent.—F. C. TERRELL.

**Hofmann's Violet.**—"Querist" wishes to be informed whether the process for the manufacture of Hofmann's violet by aid of the iodides of the alcohol radicals is still worked, and how the iodine is recovered? "Querist" reads, in the "Couleurs d'Aniline" of the "Encyclopédie Roret," that M. Levinstein patented a process, in which he uses nitrate of ethyl instead of iodide. Is this process worked? if not, why?

**Starch and Alcohol.**—(Reply to "Sciologist.")—As regards the correct composition and atomic weight of starch, it would be almost impossible to quote here more than this: that the formula of the perfectly dry substance is usually taken as  $\text{C}_{12}\text{H}_{10}\text{O}_{10}$ ; and, for all practical purposes, this may answer. The quantity of alcohol obtainable from 100 parts of starch is about 56.78 parts, varying slightly in consequence of the fact that, during the different operations by which alcohol (the ultimate product of the vinous fermentation) is formed, there are generated, in larger or smaller quantities, certain by-products, among which are glycerine and succinic acid. The mode of conducting the operations, as well as the raw material employed, influence, more or less, the quantity of alcohol which 100 parts of starch yield. In practice, on the large scale, the true theoretical quantity cannot be obtained, because it implies perfectly pure materials and a perfect mode of operating, whereby no loss should occur.

**Extract of Indigo.**—(Reply to "Indigo.")—We do not understand what you mean by "weighting"; but perhaps it may be of use to you to say that a small quantity of glycerine is sometimes added to the substance you allude to. Since the quantity of indigotine present in indigo varies very considerably, it is clear that we cannot tell you what the greatest amount of extract is which can be obtained from 1 lb. of indigo; while, moreover, the quantity obtainable depends upon the proper manipulation in preparing the extract. The best, but also the most troublesome and expensive, method of getting rid of the greenish hue you allude to, is to prepare what is known as refined indigo. Since space forbids us to enter here into further details on this subject, and since you wish for a book which will give you some information, we refer you, for the present, to "Lectures on Coal-Tar Colours and on Recent Improvements and Progress in Dyeing and Calico-Printing," by Dr. F. Crace Calvert (published at Manchester by Palmer and Howe, and at London by Triebner and Co.) There is a large work in the press, by the Editor of this paper, which will contain full and ample details on this subject, so as to enable you to work on the large scale.

## TO CORRESPONDENTS.

Z. Y. X.—Replies to querists must be sent in such a form that we can publish them. As we have often stated before, we decline to act as the medium for any secret communications. The proper course is for you to advertise.

*Lee and Nightingale.*—Mr. Alexander Gordon's paper, on "Lead Poisoning and its Prevention," has not yet been received.

*Jonathan Bowen.*—Articles, or lectures, on the subject of gases, by Dr. Odling, have frequently appeared in our columns. The notes you speak of have not been published.

*Jas. Farie, W. H. Walenn, Dr. Phipson, and P. Holland.*—Received.

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# THE CHEMICAL NEWS.

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## ON THE TIME NEEDED FOR THE COMPLETION OF CHEMICAL CHANGE.\*

By FERDINAND HURTER, Ph.D.

It is now nearly seventy years since Berthollet published his Essay on Chemical Statics, a work in which he tried to develop the principles of a then new science—the science of chemical statics.

We have not come very much nearer that final result of all chemical investigation, which Berthollet believed to be the science of chemical statics and mechanics, which would enable us to predict the phenomena from the preceding conditions.

The study of the rational composition of the chemical compounds has absorbed the attention of our eminent chemists so much that the dynamical part of our science has been but little regarded, and even the science of chemical statics is in but an imperfect condition.

Although our literature has augmented to an enormous extent, and although the science of chemistry is, in fact, the history of the force affinity, yet we cannot find means to measure the magnitude of that force. We speak of ferrous oxide, as possessing a greater affinity for oxygen than manganous oxide, but how much greater that affinity is, is as yet unknown.

The magnitude of other forces is measured by the work done in a unit of time, or by the resistance necessary to prevent the force from doing the work.

Now we know that 98 parts of hydric sulphate dissolve 65.4 parts of metallic zinc; this affords, however, no measure for the affinity of hydric sulphate to zinc. A physicist would not be content to know that a certain force may remove or lift a certain weight, but he would inquire, "What time does the force need in order to complete this work?" In the eyes of a physicist, the measure of the force which caused the solution of zinc in hydric sulphate would only be complete if we knew, besides the acting quantities, also the time which the reaction occupies.

These are the reasons which induced me to ascertain the time needed for the completion of chemical reactions.

I will now try to develop a formula which shall express the relation existing between the work done and the time required to do it. Let us take any reaction which occupies considerable time to complete itself—for example, the dissolving action of hydric sulphate on metallic zinc.

Let us, for simplicity's sake, assume a piece of zinc of prismatic form, having a base of 1 centimetre square, to be exposed to the action of sulphuric acid. Let us also suppose the piece of zinc to be protected on all its sides, except its base, against the action of the acid.

In the first particle of time, call it a second, a certain quantity of zinc will be dissolved, and an equivalent quantity of acid neutralised. Assuming that at the beginning of the reaction a quantity  $W_0$  of sulphuric acid was present, we shall at the end of the first second only have a quantity  $W_1$  available for action. In the second particle of time this process will repeat itself, and if we denominate the quantities of sulphuric acid left at the end of the first, second, third, &c., particle of time, with  $W_1, W_2, W_3$ , we shall have a decreasing series of numbers,  $W_0, \dots, W_1, \dots, W_2, \dots, W_n$ , representing the decrease of acid in course of time.

The quantities of zinc dissolved in the acid in each second will, of course, be proportional to the quantities of

acid neutralised, as well as to the depths of the layers of zinc which disappeared in the consecutive seconds.

If we represent the depth of the various layers with  $d_1, \dots, d_2, \dots, d_3$ , &c., we shall have the proportion—

$$(1.) d_1 : d_2 : d_3 = W_0 - W_1 : W_1 - W_2 : W_2 - W_3.$$

It is, further, clear that the action on the zinc, and, consequently, the depth of the disappearing layer, will be proportional to the number of particles of hydric sulphate, which exercise their influence in each moment on the exposed surface. If the molecular forces do at all act through space, the number of particles of hydric sulphate in the sphere of attraction of the exposed surface must itself be proportional to the whole quantity of acid present. I assume that molecular forces do act through distance, although but a small one. I therefore say that the quantities of zinc dissolved, or the depth of the layers disappearing, are proportional to the quantities of acid present in each moment. Now at the beginning we have the quantity  $W_0$ , but at the end of the first second only  $W_1$ , of acid exercising their influence. It is clear that we may replace the gradually diminishing force by a constant one acting during the same time, and we may therefore say that—

$$(2.) d_1 : d_2 : d_3 = W_0 + W_1 : W_1 + W_2 : W_2 + W_3.$$

From proportion (1) and (2) we obtain—

$$(3.) \frac{W_0 + W_1}{W_1 + W_2} = \frac{W_0 - W_1}{W_1 - W_2}$$

If we reduce this equation we shall have—

$$W_1^2 = W_0 \cdot W_2.$$

Had we used the more general terms, viz.—

$$W_{n-1}, W_n, W_{(n+1)},$$

we would likewise have obtained—

$$W_n^2 = W_{(n-1)} \cdot W_{(n+1)}.$$

This equation indicates that the series of numbers, representing the decrease of acid in course of time, forms a geometrical progression. I may, consequently, use the laws of geometrical progressions for my further demonstrations.

According to these laws, any one member of a geometrical progression may be calculated if the first member and the second are known. We shall therefore be able to calculate the quantity of acid left at the end of any one second if  $W_0$  and  $W_1$  are given.

The rule by which  $W_n$  is found is expressed in the formula—

$$W_n = \left(\frac{W_1}{W_0}\right)^n \cdot W_0$$

or, if we put  $a = \frac{W_1}{W_0}$ , we have  $W_n = a^n \cdot W_0$ .

In order to calculate the time necessary for the solution of the whole of the zinc, we have but to choose  $W_n$  so that  $W_0 - W_n$  is the equivalent quantity of acid to the piece of zinc in question. If we then take the logarithmic form of the last equation, we shall find—

$$n = \frac{\log. W_n - \log. W_0}{\log. a}$$

where  $n$  represents the number of seconds necessary to dissolve the whole of the zinc.

Let us now assume that the zinc had another area, larger or smaller than in the previous case—say  $c$  centimetres square =  $A$ . Then this piece would evidently be equal in its action to  $c$  pieces of the former sort. The quantity of acid available for action would decrease more rapidly. Our formula tells us that one piece of zinc is able to reduce the quantity of acid in  $n$  seconds from  $W_0$  to  $a^n W_0$ . If we desire to know the quantity of acid left after  $n$  seconds, when  $c$  pieces of zinc are acting, we shall have to apply our co-efficient of diminution,  $a^n$ ,  $c$  times, in order to find  $W_n$ . We shall therefore have  $W_n = a^{n \cdot c} W_0$ ; or, denoting with  $A$  the area of the piece of zinc,  $W_n = a^{nA} W_0$ . From this equation we derive the following one:—

$$n = \frac{\log. W_n - \log. W_0}{A \log. a}$$

\* Abstract of a paper read before the British Association, Liverpool Meeting, Section B.



From this formula, a great many interesting conclusions may be drawn.

We leave the numerous examples which might be and were produced: we will only cite the most interesting one, in order to prove the truth of the mathematical deductions.

The oxidation of manganous oxide, as carried on on a large scale under the name of "Weldon's process," is a subject with which the British Association is well acquainted. The manganous oxide is suspended as a fine precipitate in an alkaline solution of calcium oxychloride, through which a certain number of air bubbles rise in a given time. The manganous oxide offers an infinite surface to the limited surface of the air bubbles. The manganous oxide represents the sulphuric acid, and the air bubbles the zinc, of the former examples. If we, therefore, apply our formulæ to this example, we shall be able to calculate the quantity of manganous oxide left unoxidised after any period of time, assuming  $\alpha^A$  to be given. Now, if the blast-engines supply, in equal periods, equal quantities of air, we may assume  $\alpha^A$  to be constant throughout the process. This is, however, not always the case, and it is somewhat difficult, on this account, to find examples which agree perfectly with the formula. The manganous oxide itself seems to exercise different affinities towards oxygen under different conditions of alkalinity. It is, therefore, not to be expected that the results should always agree with the theoretical requirements.

In the works of Messrs. Gaskell, Deacon, and Co. in one case, a quantity of manganous oxide was converted into peroxide amounting to 19 per cent at the end of the first half hour. At the end of the fourth hour it proved, on analysis, that 81 per cent had been converted into binoxide. The question arises, what time would, theoretically, have been necessary to complete the oxidation as far as 81 per cent, if we know that in half an hour 19 per cent have been converted. By applying our formula for the determination of time to this case we arrive at the answer, 3.94 hours.

In another case the amount of peroxide of manganese formed was 58.5 per cent after two hours oxidation; at the end of four hours it amounted to 82 per cent. Our formula requires for that purpose 3.90 hours.

In a third case the amount of converted manganous oxide amounted to 67.4 per cent after three hours oxidation. To the question, how much would have been converted after five hours, our formula would give the answer 84.5 per cent; in reality it amounted to 84.4 per cent.

Gaskell, Deacon, and Co. used for some time only one blast engine. When they tried to use two, it was found that the two engines would do the same work in half the time. These facts clearly prove that the mathematical deductions are a general truth.

It may finally be mentioned, that for experimental researches, intending to obtain real values for the coefficient  $\alpha$ , the formulæ require considerable extension. We have to take notice of the concentration and temperature of the reagents. We cannot experiment on a piece of zinc in the way I indicated, and we have to introduce the surface as a function of time, as it constantly varies. I believe, however, that the co-efficient  $\alpha$  will prove a measure for affinity, because it expresses the work done by affinity in the unit of time.

The marvellous relation which Professor Bunsen found to exist between volatility of substances and their molecular weights, and which he found by measuring the time needed for the volatilisation of various compounds, gives me hope that I shall meet in the results of my further studies on this subject that simplicity which generally characterises the laws of nature.\*

\* When writing this paper I was not perfectly acquainted with the admirable researches of Professor Vernon Harcourt on the same subject. I am glad to find that my results, as far as they go, agree with those previously found by that gentleman.

## ALLOYS OF COPPER, TIN, ZINC, AND LEAD, WITH MANGANESE.\*

By J. FENWICK ALLEN, F.C.S.

IN the year 1826 a spoon, made by Messrs. Zernecke, of Berlin, was analysed, and the alloy was found to be composed of—

Copper .. ..	57.1 per cent.
Manganese .. ..	19.7 „
Zinc .. ..	23.2 „

This analysis is included in a chapter on Kupfermangan, by Mr. Johann Zenner, in his "Handbuch der Metall Legimngen," published at Quedlinburg.

Berthier produced a large number of alloys of manganese with various metals, and has recorded their principal properties.

Although there is no published account of such experiments, Dr. Percy has informed me, that some years ago he thoroughly investigated the nature of manganese alloys.

There are also specifications of patents, one in the name of Emil Stoehr, dated 1862, the other in the name of Oscar Priegur, dated 1864; both claiming the original discovery of this class of alloy.

Whilst, therefore, the alloys of copper, zinc, and other metals with manganese have been more or less known to the metallurgist for more than forty years; whilst their valuable physical properties have been fully described; whilst, moreover, manganese in its ores almost approaches iron in its abundance and in its cheapness; and, whilst for years being suffered to escape as a waste product from almost every large alkali works, we find the metallurgist has not succeeded in reducing it to serve as widely except when yoked with iron. We now claim for it a nobler affinity and a higher service.

Having had my attention directed to the subject by the late Mr. John Keates, whose name and memory, by those in this locality who leaned to science still are cherished, I have made it my study, and have been enabled to apprehend the causes that have prevented the general application of this most useful class of alloys.

To produce metallic manganese was not from the first attempted; it is with extreme difficulty that even the smallest quantities of this metal can be produced; these few prills were obtained only after the oxide mixed with charcoal had been subjected, in a plumbago crucible, to an intense heat for two or three hours.

From the first also I discarded using any of the ores of manganese, the iron and the silicon completely destroying the value of the product. Having obtained a comparatively pure oxide of manganese, recovered from the still-liquor, and having mixed this with oxide of copper, not metallic copper, together with wood charcoal, all finely ground and intimately mixed, the charge was put into a plumbago crucible, then heated in an air furnace at an intense heat for from three to four hours. It was found when the pot was taken out, that, still suspended in the charcoal, and not run down to the bottom, were innumerable fine shots of a bright white metal; these being separated by washing and placed again in the crucible and heated, fused, I may say easily, into a prill or button covered with a green layer of vitreous slag.

The process was continued until some ingots were produced, and in these experiments were made as to their malleability and ductility. This knife-blade is the first piece that was successfully passed through the rolls.

The alloy was found to be very hard and very brittle when hot, but when cold, although still hard, it rolled with ease and was highly elastic.

The proportions of the alloy were about—

Copper .. ..	75 per cent.
Manganese .. ..	25 „

\* Read before the British Association, Liverpool Meeting, Section B.



When the simple alloy had been produced in sufficient quantities, compound alloys with zinc were tried in various proportions, and these again rolled with complete success.

Certain mixtures of copper, zinc, and manganese possess the advantage both over German silver and yellow metal, that, whereas, the one will only roll cold, and the other hot, the manganese alloy rolls from hot to cold.

The laboratory experiments having been completed, an air furnace was built in which a 100 lb. plumbago crucible was used.

The results were precisely the same as those obtained in the laboratory, only it was found that, by stirring the charge a few minutes before the crucible was taken out of the fire, by far the greater portion of the metal that before was in small fine shot, needing very careful washing, now settled to the bottom of the pot, and could be poured out as a bar or ingot, the slag also melting, and the unconsumed charcoal floating on the top. This experiment was continued until several hundredweights of the alloy were produced, so that it may be subjected to various tests, and also that some approximate estimate of its cost and value might be formed.

As a simple alloy, in which the proportions of manganese ranged from 5 per cent to 30 per cent, it is both malleable and ductile, with a tenacity considerably greater than that of copper.

With zinc a compound alloy very closely resembling some of the qualities, not the best, of German silver is obtained. The alloy of copper and manganese would also combine with tin, lead, and other metals, and from these castings were made which were applied as bearings for machinery.

It was not the nature of the metal in itself that prevented its being widely used; it was its cost. The waste of manganese is very considerable, over 10 per cent remaining unreduced and forming a silicate; the wear and tear of the plumbago pots and the furnace itself incurred a large expense; and in proportion to the quantity of metal produced, the fuel consumed, and the labour expended, were great. The work was, therefore, for a time arrested by an obstacle which not unfrequently bars the path of the inventor. It was, however, now a question of cost, and a firm belief that a material so abundant, and a product so valuable, had a destiny, enabled one to look hopefully on the dilapidated furnace and the unused metal. The waste of manganese in alloys rich in that metal will, we fear, always be considerable; but the value of the raw material would permit some such loss, could the other points be attained; and these, we believe, have to be achieved. These ingots have been produced by heating the mixture of carbonate of manganese with oxide of copper and charcoal in a tolerably large reverberatory furnace, and not in a small and costly pot. The fuel used has been principally the common slack, or small coal of the district, and not coke; the labour has been proportionately reduced; and we believe you have before you a series of alloys that will ere long play no unimportant part in the manufactures of our country.

It behoves one to say that it is the beautiful furnace arrangement of Mr. Siemens that has enabled us to overcome our difficulties. A furnace planned by Mr. Siemens has supplied the intense heat needed, with a non-oxidising flame, in a quiet atmosphere.

It merely remains for me now to place before you the following series of specimens.

1st. Manganese and copper in various proportions from 35 per cent to 5 per cent of iron, as ingot, sheet, or wire.

2nd. Copper, zinc, and manganese, also in different proportions, and in a variety of applications.

3rd. Copper, zinc, manganese, and tin as ingots and as bearing.

4th. Copper, manganese, and tin in several different proportions as bars.

5th. Copper, manganese, and lead.

## ON ARTIFICIAL STONE AND VARIOUS KINDS OF SILICA.\*

By the Rev. H. HIGHTON, M.A.

SILICA is found in various forms more or less soluble. Some kinds can only be united with alkalis in the heat of a glass furnace; other kinds can be dissolved under a high pressure and after a considerable lapse of time by solutions of alkalis; other forms, again, to which the author particularly wished to call attention, can be dissolved under proper precautions even in the cold. Natural silica of this kind was exhibited both from Germany and England. By means of this soluble silica artificial stone can be formed harder than any natural stone except the very hard granites and primitive rocks. The process is as follows:—

A concrete is made with any good hydraulic cement. When this is dry it is steeped in an alkaline solution of silica, in which is placed a quantity of free silica. The following chemical process then takes place:—The lime in the concrete extracts the silica from the solution, leaving the alkali free, which immediately attacks the free silica and conveys it in its turn to the concrete. This process goes on continually till the lime in the concrete is saturated with silica. By this process, within a week the strength of the concrete is increased from 50 to 150 per cent, and by a longer continuation of the steeping the strength is still more increased.

As the alkali acts only as a carrier of the silica, it is used over and over again; and it is in this that the economy of the manufacture consists.

The following is the comparative resistance to a crushing force of several kinds of stone:—

	Per sq. inch. lbs.
The Silicated Concrete, or Patent	
Victoria Stone .. .. .	6441
Aberdeen Granite.. .. .	7770
Dartmoor Granite.. .. .	6993
Peterhead Granite .. .. .	6216
Yorkshire Landing .. .. .	5851
Stafford Blue Brick .. .. .	4032
Portland Stone .. .. .	2426
Bath Stone .. .. .	1244

The stone formed in this manner has been tried as a pavement in the busiest part of Cheapside, and in many other parts of London, and for steps, lintels, sills, &c., in many parts both of this kingdom and abroad as well as in India.

The whole of the stone in the new warehouses, 27, St. Mary Axe, is made in this manner.

As a cheap strong stone, when manufactured on a large scale, it is likely to supersede natural stone, except where the latter is very cheap and abundant.

In localities, as on the Thames, where there are facilities for obtaining good hydraulic cement and hard broken stone, it can be manufactured at a much lower cost than Yorkshire or other stone can be procured.

## ON THE ANTISEPTIC TREATMENT OF CONTAGION AS ILLUSTRATIVE OF THE GERM THEORY OF DISEASE.†

By WILLIAM HOPE, V.C.

At an experimental farm belonging to a company in which I was interested pecuniarily and scientifically, rinderpest broke out in the summer of 1867 among a herd of 260 or 270 cows. I sent for Professor Brown from the

\* Abstract of a paper read before the British Association, Liverpool Meeting, Section B.

† Read before the British Association, Liverpool Meeting.



Privy Council, who, after making his inspection, said he had found every symptom of rinderpest except one, and that was one of the later symptoms generally, although not invariably, preceding death, namely ulceration of the mouth. Next the dreaded ulcers appeared, and Professor Brown told me there was no means of cure known to science, that the disease was practically incurable, that in the present instance there was no sober, serious chance of saving a single animal out of the whole herd. At my particular request Professor Brown explained the progress of the disease, and the peculiar difficulties to be encountered.

Immediately afterwards I undertook the treatment of one-half of the animals. I got all the quick-lime I could lay my hands on, with which I formed broad roadways all round the sheds, three or four inches in depth, and placed pyramids of it along the pathways in the sheds, and slaked it *in situ*, until all the animals were coughing and choking to an alarming extent. I then obtained the report of the Royal Commission on the Cattle Plague, and specially studied the experiments made by Mr. Crookes, F.R.S., which chimed in exactly with my own instincts, and his reasoning being logical and scientific he made a disciple of me at once. I therefore telegraphed to Manchester for a barrel of genuine carbolic acid, and determined upon combining the two treatments of liquid diet for the purpose of guarding against the secondary symptoms, with what I might term the chemical treatment recommended by Mr. Crookes. The result was that, while every single animal that I did not take charge of either died or was slaughtered, I succeeded in saving every single animal that I did take charge of; and if you consider the very large scale on which my operations were conducted, the completeness and thoroughness with which the infection had been disseminated throughout the herd, and the fact that rinderpest is the most infectious of all disorders, whether among mankind or the animal creation, known to science, no one can, I think, doubt that the treatment suggested by Mr. Crookes is a radical and complete specific against rinderpest.

What I wish to call the attention of the section to is the fact that I saved the lives of those animals not by any medical treatment, properly so-called, of the animals themselves, but by an unremitting, ceaseless chemical onslaught on the germs of the disease. I argued in my own mind that a theory such as the germ theory of disease could not, in the nature of things, be partially true; it must either be altogether true or altogether false. If true, it was the most hopeful theory that anyone could comfort himself with in face of an outbreak of zymotic disease, because it afforded some firm and sure foundation for treatment. A purely medical treatment, properly so-called, of infectious disease, always has appeared to me, if I may be pardoned for the expression of so heretical an opinion in such orthodox company, to be empirical to the last degree.

It is probable that medicines act physically as well as chemically, but I am not aware that anyone has been able to give a very satisfactory explanation either of the physical or the chemical action of organic medicines, whether exhibited in the human subject or in a lower organism. The chemical action of many inorganic medicines is, no doubt, perfectly understood; but even the administration in the nursery of a home-prescribed dose of rhubarb and magnesia has always seemed to me the height of empiricism, for here the nurse boldly invites the actions of inorganic and of organic substances, although, no doubt, she exhibits her agents with, on the whole, a happy result. But at last we appear to be getting upon some firm scientific footing, for clearly it is more scientific to attack the germs producing disease with a chemical agent whose action is ascertained, than to exhibit in the inside of the patient affected a variety of organic and inorganic substances which can only at best act upon the disease, that is upon the germ, through the secondary agency of the patient himself. Of course in rinderpest,

or in any other infectious disease, the disorder may have proceeded too far before the patient is taken in hand to admit of the possibility of a cure, and death may result from a secondary action set up during the progress of the disease, even although the primary cause of the disease—that is, the germs—may have been altogether exterminated. But it has always seemed to me that this case of the chemical treatment of rinderpest upon so large a scale, is one of the most entirely practical proofs of the germ theory of disease that has yet been obtained, and it is for this reason that I have ventured to communicate these details to this section. In doing so I am anxious to explain distinctly what it is that I mean by the words “germ theory of disease,” for the words are so often used that many persons attach various meanings to them.

By the “germ theory of disease” I simply mean the process by which an infectious disease having once originated is disseminated and communicated from one subject to another. I do not desire to apply it in any way to the *origin* of such diseases. Probably we shall never know the truth as to their origin, for it is difficult to see how any accurate observations can be conducted upon such a point. I therefore wish Mr. Crookes’s chemical treatment for infection, as successfully carried out in the case above described, to be considered as evidence only in favour of the theory that infectious disease is propagated not originated, on what is known as the germ theory. Of the origin of such diseases I will merely say this—that I have the greatest possible difficulty in believing that the germs of Asiatic cholera existed in a passive state from the creation of the world, whenever that may have been—on which point again I would offer no opinion, for I fear that I am getting on dangerous ground—down to the year 1817, when suddenly called into existence by getting into the congenial climate of a Hindoo stomach.

Perhaps I should now communicate a further experiment that circumstances forced upon me in the chemical treatment as disease attacking, as distinguished from medical treatment of the patient attacked, in this next instance, as I am almost afraid to confess, in the human subject. Turning again to the paper from which I read an extract, I will read a prophecy which I was rash enough to publish at the end of it, in, as you will recollect, the month of November, 1867, that similar treatment would, for similar reasons, prove equally successful in diseases attacking human beings. After reading the passage in question, Mr. Hope proceeded to say:—In the spring of the following year, namely, 1868, I returned home late one Saturday evening, and found, to my horror, that my eldest child was laid up with a violent attack of scarlet fever. It so happened that scarlet fever was the disease, of all others, that I most dreaded for children; and this was a violent attack, with acute symptoms both in the throat and of fever. My wife, however, having authorised the exhibition of carbolic acid, and having already isolated the child, I proceeded chemically to attack his enemy, the scarlet fever germs. The first step was to kill the germs which caused the pain in the throat and the difficulty in swallowing. This was effected by a gargle of one part of carbolic acid—I mean of the pure white carbolic acid manufactured by Calvert—to 200 parts of water. The effect was instantaneous, and the result most encouraging. Our efforts were redoubled. We attacked the germs in every direction, and showed them no mercy. Cloths dipped in a 2 per cent solution of carbolic acid were hung up over the bed and in different parts of the room. The same 2 per cent solution was sprinkled over the bed clothes and over the carpet and furniture. A basin of the same was always kept at the door of the dressing-room, through which alone ingress and egress were permitted, so that the few persons allowed to come into the room might wash their hands in it before going to other parts of the house. During all Sunday and all Sunday night the same treatment was incessantly kept up, and the patient took occasionally small sips of a solution



as weak as 0.2 to 0.3 per cent, and the poor germs of the scarlet fever could not get any rest, and could find no place of security. The result was that when the Monday morning came, the patient was fast approaching convalescence. I should mention that some very simple febrifuges had been given to the patient in addition to the carbolic acid which had been administered to the disease. I have not preserved a record of how these were given, but I am quite sure that if I had there is no one in this room who would say that they were sufficient by themselves to cure a bad case of scarlet fever. Convalescence proceeded most satisfactorily. When the peeling stage arrived, the entire skin of the child was washed all over from time to time with a 1 per cent solution of carbolic acid, and he eventually made a perfect recovery without a relapse, and without any of those dreaded after-consequences which are so disastrous in many cases. Before, however, he could have been certified as safe for other children to approach, some members of the household displayed a somewhat rebellious spirit towards the restrictions imposed on communication with the invalid; and on my return from London one evening I was shocked to learn from my wife, who understood the danger, that several such visits had been paid to the patient when she was off sentry. Up to that time—the patient having been at once isolated, and rigorous measures of disinfection carried out all through the house, as well as in the sick room—the infection had not spread. But I said at once that all our previous care was now thrown away; and it proved to be the case, as in a few days the other children were all attacked also. But the enemy being in their case fiercely assaulted by carbolic acid on his very first appearance, their cases were much milder than the first attack. In the case of a child of about one year old, the carbolic acid was applied to his throat by the steam of hot water, which he was made to inhale, in every instance with the happiest effect. Eventually the disease was entirely burnt out; the recoveries were in each case most satisfactory, and in no case were there any bad after results. This instance by itself would not, of course, carry very much weight, but following a case on so great a scale as that I previously described, and the treatment being the direct consequence of the former, and based upon a distinct and intelligible theory, I have thought that you would consider it also of some interest.

### DUST AS A FERMENT.

By CHARLES R. C. TICHBORNE, F.C.S., M.R.I.A.,  
Chemist to the Apothecaries' Hall of Ireland, &c.

THE celebrated lecture and papers upon "Atmospheric Dust," published last year by Professor Tyndall, brought prominently before the public a subject which is intimately connected with the one which I have taken for my text on this occasion, and which for many years I have looked upon as one of our most fertile sources of diseases in large towns, having, in 1866, when the cholera was raging in Dublin, drawn attention to the dangerous character of our street dust.\*

It is, however, my intention, in the present paper, to place simply on record some experiments which have been performed from time to time and all bearing upon this most important subject.

Metropolitan towns are unfortunately those which, as a rule, suffer most from zymotic diseases, for the accumulations in a town of importance bring their attendant ills. Every acre of buildings, and every 1000 of increase in population, bring irremovable dirt. The vitiation of localities is not merely a matter of the numerical proportion of the inhabitants, but it becomes changed in character and more dangerous from the destruction of the numerous compensators or renovators provided by nature. The population seek suburban dwellings, and expend

fabulous sums in the extra expenses incurred thereby. Those who are forced to remain in the seething mass are, but too frequently, those who suffer most from this dirt, and who, from their careless habits of living tend most towards its advancement.

A good supply of water has been insisted upon for many years, and sanitary measures have been taken in most large towns in regard to this important subject. The gaseous condition of the atmosphere has also received some considerable attention, particularly in connection with the effects produced by manufactories. I cannot help thinking that, as regards epidemic diseases at least, the influence of these sources of contamination has been a little exaggerated, except in the cases of a few of the direct blood-poisoners, such as sulphuretted hydrogen. A most important substance, however, in connection with our sanitary condition, is what has been termed "Atmospheric Dust," or the floating solid constituents of our air. Although well known, it was not much investigated from a scientific point of view in this country until Dr. Tyndall, Professor Lister, and a few others drew attention to it. Tyndall in his experiments has demonstrated, however, one important point, namely, that this atmospheric dust may be viewed as organic matter. But its proximate analysis is one of extreme difficulty, and the researches which have been made in this direction do not throw much light upon the subject. Dr. Angus Smith has, however, with great perseverance, worked out some valuable facts, bearing upon this part of the investigation.

It is evident from the difficulty in giving a critical examination of atmospheric dust that the point of enquiry tends more in the direction of the local pabulum of these particles, and here it may be as well to state that I strictly confine the term atmospheric dust to that dust which floats at a certain altitude, and which has been winnowed from the inorganic particles, except small traces of sodium that are not worth consideration. It is this organic portion that contains the germs which, if not absolutely essential to all changes coming under the names of fermentation and putrefaction, are the prime movers in such phenomena. As Professor Lister says:—"The sporules, besides being produced in incalculable multitudes, are of extreme minuteness, and constitute a very fine dust, which cannot fail to be wafted and extensively diffused through the air." "The particles of dust which are rendered visible to the eye by being illuminated are gross compared with the sporules of a fungus."

As regards much of the pabulum of the atmospheric ferments and the ferment itself, it lies on our shelves, floors, and streets. This is the nest in which germinal matter is fostered and wafted through our atmosphere. Each dust must partake more or less of the local condition of the place.\*

The following paper is written with a view to give the analysis of some of this dust, which, to a certain extent, may be considered as typical; also to determine as far as possible their chemical activity as ferments, or their adaptability to become ferments.

#### Street Dust.

The two following samples were taken from our principal streets, both of which are paved with a very hard and non-absorbent stone.

#### Grafton Street Dust, dried at 100° C.

Inorganic matter	.. .. .	68.9
Organic	.. .. .	31.1
(Containing nitrogen, 1.07; carbon, 43.7)		100.0

#### Nassau Street.

Inorganic matter	.. .. .	54.8
Organic	.. .. .	45.2
(Containing nitrogen, 2.1; carbon, 57.5)		100.0

\* Dr. Percy says that the Library of the British Museum gives a dust having 50 per cent of organic matter in it. ("Dust and Disease," page 4.)

\* Vide CHEMICAL NEWS, July 5th, 1867; Irish Times, Oct. 9, 1866.



The organic matter in both these dusts consists of stable manure finely ground; a glass of very low power was all that was necessary to prove this fact, but part of it, from its minute state of division, was evidently very old.

*Nassau Street Dust* was taken from the locality of a cab stand, and the organic matter was here in an incipient state of change; it exhibited traces of ammonia, whilst these street dusts as a rule generally give, if anything, a slightly acid reaction. Street dust, then, consists of stable manure and stone finely ground; the traffic on the streets supplying the grinding power. On a macadamised road, irrespective of the effects of the traffic, the inorganic matter greatly preponderates, and as it is soil with which the animal matter is attenuated, the mischief is at its minimum. Not so as regards the streets of large municipal boroughs, which are generally paved with a hard stone, which would have no other effect upon this substance than that of an attenuator.

*Dust taken from the Top Seats at Merrion Hall, Dublin.*

Organic matter	..	..	32.1
Inorganic matter	..	..	67.9
			100.0

*Dust from Gallery of the Theatre Royal, Dublin.*

Organic matter	..	..	53.2
Inorganic matter	..	..	46.8
			100.0

*Dust from the Ventilatory Space above the Gas in Ancient Concert Room, Dublin.*

Organic matter	..	..	35.7
Inorganic matter	..	..	64.3
			100.0

These three last specimens as regards general appearance resemble each other considerably. Merrion Hall is the largest place of worship in Dublin, and is comparatively a new building. The other two buildings are much older. The Theatre we presume receives a much greater number of visitors in the course of the tenanted months. All these buildings are well ventilated. The large amount of iron in the dust is peculiar; for instance, that obtained from the Ancient Concert Rooms gave 21 per cent as the amount of peroxide in the inorganic matter.

*Dust from the Walls at the Top of Nelson's Pillar, Sackville Street, Dublin.*

Organic matter	..	..	29.7
Inorganic matter	..	..	70.3
			100.0

Height, 134 feet.

This monument is built of granite, and the residue of inorganic matter in this case consisted of mica-felspar, &c. If we take into consideration the position and the difficulty in not detaching a considerable quantity of stone, although a feather was used, the amount of organic matter was truly extraordinary, and if we put it down as containing over 50 per cent of organic matter, as actually contained in the dust if it could have been removed by itself, we shall not be far off the mark.

Some further experiments were then instituted to determine how far, and to what extent, these dusts would operate as ferments, and a volumetric system of measuring the intensity of any process of fermentation was contrived. It enables the operator to watch the process much more definitely than he could by ordinary observation. The process is based upon the reduction of the nitrate of any base to a nitrite in the presence of substances undergoing fermentation. In these experiments the following precautionary measures were adopted, so that, as far as possible, all the fermentations induced were proper to the ferments used in the experiments.

Distilled water was taken and permanganate of potassium added until a distinct red colour remained, it was then distilled, the first portion being rejected. The remainder was then used for the experiments. The ashes of yeast may be employed to supply the mineral ingredients, but in these experiments a mixture of nitrate of potassium, phosphate of sodium, and a little sulphate of potassium and chalk to neutralise the acids formed were employed, the pabulum used being a mixture of cane and milk sugar. The mixtures were well boiled in each experiment in their respective flasks, and after closing with cotton wool and cooling, the ferments were added. They were all placed in a similar position and submitted to a pretty constant temperature night and day, varying from 20° to 28° C.

*Expt. 1.*—In this case the above mixture, which was found by experience to be one easily convertible into lactate of calcium in the presence of ferments, was submitted for some two to three weeks to the temperature conducive to such changes. It showed no decomposition for fourteen days, but at the expiration of that time there were indications of a fresh molecular arrangement, but no particular development of organisms. This evidently showed that the precautionary method taken for the destruction of the germinal matter had more or less been perfect. The opening and closing of the flask would more than account for the change evinced.

*Expt. 2.*—In this case  $\frac{1}{4}$  of a grain of nitrate of potassium was used to the fluid ounce of the fermentable mixture. The ferment was the mould of cheese. It was examined from day to day in the following manner:—5 c.c. of the clear liquid were withdrawn with a graduated pipette, and the level of the remaining liquid marked on the flask, so that it can be made up to the original level if there is any loss from evaporation. The 5 c.c. were then mixed with a little mucilage of starch and iodide of potassium added. On acidulating with sulphuric acid, blue iodide of starch was at once formed, representing two  $N_2O_3$  present. A volumetric solution of hyposulphite of sodium was then added until decolourisation of the iodide of starch took place. Each degree of hyposulphite consumed would represent 0.28 of a grain of nitrate as being reduced to nitrite.

	Nitrites.	Nitrates.	Remarks.
After the 1st 24 hours	{ 0.5 hyposulphite consumed.	Present.	Fermenting slowly.
„ 2nd 24 hours	Trace.	Present.	{ Increased fermentation.
„ 3rd 24 hours	None.	Present.	{ Vigorous fermentation, thick mycelium, and great quantity of spores

In seven days the liquid had become thick with the mycelium, and crusts of lactate of calcium began to form; in forty-eight hours afterwards the contents of the vessel were solid.

This experiment was repeated again, but with 3 grains of nitrate of potassium to the fluid ounce the results were different, for in this case nitrites were present during the whole of the fermentation. This is rather a curious observation, although the entire of the nitrates was not destroyed; the first instance we had little or no evidence of the nitrous acid. It is probable that in the reduction of the nitrates preparatory to the assimilation of its nitrogen, a nitrite is the first stage, but that if the ferment bears a considerable proportion to the nitrate present, or that the fermentation is going on very rapidly, the nitrogen will be assimilation in the form of some lower compound of nitrogen. There is no evidence of the molecule  $N_2O_3$  during the fermentation, although the supernatant fluid is always slightly acid. One point of importance is evident that, in the examination of potable waters, if no nitrates are present, it is no proof that decomposition is not actually proceeding at the time as regards the organic matter therein.

*Expt. 3.*—Street dust was allowed to remain some time at a temperature of 20° to 28° C.; it became after a little



while covered with a thick mould. This mould acts as a ferment of great activity when placed in the saccharine mixture described above. After being partially dried it seemed more active, weight for weight, than the mould from rotten cheese.

The following results were obtained on fermenting the usual solutions of sugar, &c., with the addition of 3 grains of nitrate of potassium, and sufficient street dust to represent 1-2000th part of the entire mixture. (In adding this and the other dusts as ferments, only the organic portion was taken into consideration, the weighing being regulated accordingly.)

Days.	Degrees of volumetric solution of hyposulphite of sodium required to decolourise the iodide of starch from the liberated $N_2O_3$ in 5 c.c.	Remarks.
2	0.3	
3	3.5	{ Spores, &c., considerably developed.
4	9.5	{ Fermentation very active; beautiful mass of mycelium.
5	0.8	{ Fermentation going on very actively.
6	8.5	{ Fermentation very strong, large quantity of carbonic acid given off, and thick layers of mycelium on the surface.
7, 8, and 9	8.5, 7, and 2.5	{ Fermentation on the decline.
10 and 11	1	{ Liquid had become very thick and crusts of lactate of calcium beginning to form.

*Expt. 4.*—Was a similar examination of the activity of the dust obtained from Nelson's Pillar, a monument in Dublin, 1-2000th part being used.

Days.	Degrees of volumetric solution used	Remarks.
2	3.5	{ Thick coating of mycelium at once formed.
3 and 4	4 and 7	{ Fermentation going on vigorously.
6 and 7	8.5 and 8.5	{ Fermentation seemed upon the decline.
10	.. .. .	{ Quite solid from lactate of calcium; vessels could be inverted without contents falling out.

*Expt. 5.*—The dust from the Ancient Concert Rooms was obtained from the ventilating space above the public room. This, it will be remembered, contained a considerable percentage of iron.

Days.	Degrees of volumetric solution.	Remarks.
2	.. trace of nitrite ..	{ No perceptible sign of fermentation.
3	.. .. 1.0 .. ..	{ Slight sign of fermentation.
4	.. .. 3.5	
5	.. .. 9.0	
7	.. .. 10.0	
8 and 9	.. 10.0 .. ..	{ Fermentation seemed on the decline.
10	.. .. 8.5	
12	.. .. 4.0 .. ..	{ Lactate of calcium began to form slowly.

*Expts. 6 and 7* were, respectively, with dust from the Theatre Royal and Merrion Hall, Dublin. The first was almost exactly similar to the fifth experiment, but the dust from Merrion Hall approached more nearly to the fourth experiment in its results.

In conclusion, I may remark that, although if I had had time to repeat these experiments, many points in the

details of manipulation would have been improved, still the results are of some importance.

They conclusively prove the power of dust as an active ferment.\* Also, the estimation of the  $N_2O_3$  as a criterion of the extent, or intensity, of such an action is, I believe, capable of further development. Thus, a slight fermentation that would not probably be perceived could not escape observation by this method. These experiments, as far as they go, seem to point to a curious phase of the subject—that is, that dust taken at a great height, and in such a position as in the fourth experiment, should appear to have as great, or greater, activity than that which would be obtained from a building which is nightly crowded to suffocation. This, in some measure, may be due to the extreme levity of the spores, which are supposed to be the life of the dust, and which lightness may be described as almost approaching volatility. *There is, probably, an altitude of the maximum of activity for all localities as regards dust.* It is so light that even that obtained in an ordinary house contains a large portion that refuses to sink when thrown upon water; and, even when the vessel is placed beneath an air-pump, a large percentage floats. To me the activity of the dust taken from the top of the monument 134 feet high is something marvellous—this source so far removed from the busy streets—yet its organic matter contains what is capable of splitting up, in a short time, hundreds of times its own weight.

I am aware that the results obtained, and detailed in this paper, are not so elaborate as I should wish, but they are experiments in which time is an important item; they are, however, quite sufficient to prove the value of such investigations. Microscopy, at present, is not likely to throw much light upon this subject, except in conjunction with some such work as detailed in the present paper.

## SOLAR SPECTROMETRY.

### REVERSAL OF THE SODIUM LINES IN THE SPECTRUM OF THE UMBRA OF A LARGE SPOT NEAR THE EASTERN LIMB OF THE SUN.

JUST as we go to press we receive from Prof. Morton a letter with the following important communications by Prof. C. A. Young, which will appear in the next number of the *Journal of the Franklin Institute*. We have not time to get the drawings engraved, but Prof. Young is writing an article of some length, with numerous illustrations, which, through the kindness of Prof. Morton, we hope shortly to give.

Dartmouth College, Hanover, N.H., Sept. 26, 1870.

My dear Sir,—I write to inform you that, last Thursday, September 22nd, about 11 a.m. Hanover mean time, I was so fortunate as to see the sodium lines  $D_1$  and  $D_2$  reversed in the spectrum of the umbra of a large spot near the eastern limb of the sun. At the same time c and f lines were also reversed, but with the great dispersive power of my new spectroscope I see this so often in the solar spots, that it has ceased to be remarkable. In the umbra of the spot the  $D_3$  line was not visible, but in the penumbra was plainly seen, as a dark shade. I am not aware that this reversal of the sodium lines in a spot spectrum has ever been observed before; its reversal in the spectra of prominences is not very unusual. A small prominence on the western limb of the sun, which was visible the same forenoon, presented all the following bright lines, viz.: C,  $D_1$ ,  $D_2$ ,  $D_3$ , 1474',  $b_1$ ,  $b_2$ ,  $b_4$ , 1989.5, 2001.5, 2031', F, 2581.5, 2796', and h; fifteen in all. In the

\* If it is required to manufacture butyrate or lactate of calcium practically, I would never advise the use of cheese as a ferment, if any active dust could be got (I do not think there will be any difficulty as regards this point); to get rid of the quantity of extraneous matter which is introduced by the cheese is, however, very frequently very difficult. A little dust, separated from the coarser particles by elutriation, is the correct ferment.



spot spectrum the magnesium lines  $b_1$ ,  $b_2$ , and  $b_4$  were not reversed, but while the shade which accompanies the lines was perceptibly widened, the central black line itself was thinned and lightened.—Yours, &c.,

C. A. YOUNG.

Prof. Henry Morton.

#### PHOTOGRAPHS OF PROTUBERANCES ON THE SUN'S LIMB.

Dartmouth College, Hanover, N.H., Sept. 28, 1870.

My dear Sir,—I write to tell you that this afternoon, with the help of Mr. H. O. Bly, our photographer, who has assisted me in the matter with great skill and interest, I have succeeded in obtaining photographs of protuberances on the sun's limb, of which I enclose a specimen. They were obtained by attaching a small camera to the eyepiece of the telescope and opening the slit somewhat widely. We worked through the hydrogen line near G. As a picture, the little thing amounts to nothing, because the unsteadiness of the air and the mal-adjustment of the polar axis of the equatorial caused the image to shift its place slightly during the long exposure of three and a half minutes which was required, thus destroying all the details. Still, the double-headed form of the prominence is evident, and the possibility of taking photographs of these objects is established. Success will depend upon the use of more sensitive chemicals (those used to-day were such as are ordinarily employed for portraits), and a very careful adjustment of the equatorial axes and the clock-work. I fear a telescope of much larger aperture than mine will also be found necessary, in order to produce pictures that will really give much of an idea of the form and texture of these beautiful clouds. I may add, that between 3.50 and 4.30 o'clock this afternoon the umbra of the spot upon which I made the observation of the sodium lines, as communicated to you a few days ago, reversed the following lines (ranged in order of brightness), viz.: C, F,  $D_3$ , 2796 K, (Hyd.  $\gamma$ ),  $b_3$ ,  $b_1$ ,  $b_2$ ;  $D_1$ ,  $D_2$ ,  $h$ ,  $b_4$ , and 1474 K. The brightness of  $b_3$  was remarkable. Another spot, just south of this nucleus (which was the most southern of four in the same penumbra), also reversed the hydrogen lines very finely, and on opening the slit a little, it was found that the phenomena was caused by two enormous protuberances or luminous clouds, which in the spectroscope shone brightly even upon the surface of the sun. Their form could be distinctly traced—at 4.05 it was as given below: the right-hand one terminated in or close to the nucleus of the spot; the other and larger, in the penumbral region. The whole length in right ascension, determined by the time required for them to pass the slit when the clock work was stopped, was 16.5 secs. of time—a little more than 4' of arc, or 111,000 miles. They extended from the spot which was nearing the western limb, nearly to the centre of the sun. At five o'clock they were still visible, but much fainter. When brightest I was able to see their form, even through  $h$ ; the lines other than hydrogen which they showed (notably  $D_3$ ), were limited to the immediate neighbourhood of the spot group.—Yours truly,

C. A. YOUNG.

Prof. Henry Morton.

#### NOTICES OF BOOKS.

*Annual Report of the American Institute of the City of New York for the Years 1868 and 1869.* Albany: The Argus Co., Printers.

WE owe to the kindness of the Directors of the American Institute the receipt of this large and valuable volume, a tangible proof of the interest taken by the citizens of the great Trans-Atlantic Republic, in science and its useful applications to the various pursuits of daily life. The volume before us, 1125 pp. in octavo, contains:—A review of the operations of the Institute, presented by the Board

of Trustees at the annual meeting, held on February 4th, 1869; an exhibit of the receipts and expenditures during the year; the annual reports of the several standing committees of the Institute; twelve scientific lectures delivered at Steinway Hall, in the city of New York, under the auspices of the American Institute; the transactions of the Farmers' Club, including communications from residents of other States; the proceedings of the Polytechnic Association, embracing notes on progress in science and art, both at home and abroad; and, lastly, the discussions of the Photographical Section of the American Institute. As a proof of the excellent arrangement of the Institute, we may state that, among others, it has committees for manufactures and machinery; chemistry, mineralogy, and geology; optical science; civil engineering and architecture; agriculture; horticulture; and commerce. Among the subjects of the lectures given we may notice the following:—"On the Philosophy of the Tea-Kettle," by Prof. Silliman; under this very homely title the eminent *savant* elucidates, in a very clear and precise manner, some of the most interesting facts bearing upon the doctrine of caloric and its application to steam machinery. "On the Telescope," by Prof. Alexander; the lecturer enters into some particulars now rarely, if at all, mentioned, bearing upon the invention of the telescope, which he clearly proves to be due to Hollanders. "On the Philosophy of the Oven," by Prof. Horsford; this lecture contains not only a valuable record of the principles involved in the art of making bread, but also interesting historical and archaeological matters. "On the Spectroscope," by Prof. J. T. Cooke; an excellent and very pleasantly written account of the spectroscope and its many applications. "On Modern Engineering," by the Hon. W. J. McAlpine; this paper, although brief, gives a complete review of the subject alluded to. These lectures, although occupying a comparatively small portion of this large volume, are among the most valuable of its contents, and are all and severally models of lectures, as they should be given, to unite the *utile dulci*. It is impossible to give even the briefest review of the varied contents of the rest of this volume, full as it is of useful and valuable information on so great a variety of subjects. As a work of reference this, the twenty-ninth, Annual Report of the American Institute of the City of New York, will form a valuable addition to European libraries and book-shelves.

#### CORRESPONDENCE.

##### PURE SCARLET.

*To the Editor of the Chemical News.*

SIR,—In this week's CHEMICAL NEWS (No. 568), appears a statement, copied from the *American Journal of Science*, relative to the fugacity of pure scarlet, of which a water-colour cake was purchased, made by the English firm of Messrs. Winsor and Newton. As the paragraph in question may tend to damage their reputation, permit me to observe that every artist knows or ought to know—for a knowledge of the materials of art is by no means universal—that pure scarlet is the most fugitive colour in the whole range of artistic pigments. In my edition\* of "Field's Chromotography, or Treatise on Colours and Pigments as used by Artists," this colour is noticed as follows:—

"Pure Scarlet, or Iodine Scarlet, is an iodide of mercury, having the body and opacity of vermillion, and being as much inferior to it in permanence as it is superior in brilliancy. Of all artistic pigments it is at once the most dazzling and the most fugitive, and should have no place on the palette. If used, it should be with an ivory knife, as iron and most metals change it to colours varying from yellow to black; hence it should never be com-

\* London; Winsor and Newton, 1869.



pounded with metallic pigments. So sensitive, indeed, is it to the slightest touch of metal, that it has been known to turn to a dull brown merely by being washed over with a colour which had been taken out of its saucer with a penknife. In the cake, it must be carefully kept wrapped up in paper, otherwise the presence of metal tubes or a knife in the colour-box may spoil it. By a foul atmosphere the scarlet is utterly destroyed, and even metallised. In contact with the air it quickly fades away, and has been found to vanish completely when exposed to light alone. Employed in water, a thick glaze of gum-arabic or gamboge adds to its stability. As a landscape pigment, the colour is out of the general scale of nature, but in flower painting its charms are almost irresistible. Nothing, certainly, can approach it as a colour for scarlet geraniums, but its beauty is almost as fleeting as the flowers."

To this let me add, in the words of the same edition, "The palette wants weeding, not only of the bad new colours, but of the bad old colours. This, however, must be a work of time, and depend, not upon the colourman—for where there is a demand there will be a supply—but upon the artists themselves. To this end an increased acquaintance with the properties of pigments is required, whereby they may be able to choose the fast from the fugitive." To enable them to do so forms one of the chief objects of Field's work, and although naturalists, botanists, &c., are not, strictly speaking, artists, yet they so often have occasion to use colours that some knowledge of pigments would save them much trouble and annoyance. Allow me, therefore, to recommend to artistic science and scientific art a perusal of the "Chromotography."—I am, &c.,

THOMAS W. SALTER, F.C.S.

New Wandsworth, S.W.

## MISCELLANEOUS.

**Church's Laboratory Guide.**—We understand that Professor A. H. Church's "Laboratory Guide" will shortly appear in an Italian translation, for use in the agricultural departments of the Royal Institute for Professional Education in the kingdom of Italy.

**The Quality of the Gas Supplied to London.**—Dr. Letheby, the Chief Gas Examiner appointed by the Board of Trade, has recently reported to the Corporation of London and to the Metropolitan Board of Works on the quality of the gas supplied by the Chartered, the Great Central, the City of London, the Imperial, and the South Metropolitan Gas Companies; from which it appears that the average illuminating power of the common gas has ranged from 15.68 standard sperm candles, in the case of the Imperial gas at the testing place at Camden Town, to 18.34 candles in that of the Great Central gas. The average quality of the gas at each of the testing places during the quarter has been as follows:—Great Central gas, at Friendly Place, 18.34 candles. City of London gas, at Cannon Street, 17.37. Chartered gas, at Leadenhall Street, 17.64; at Gray's Inn Lane, 16.93; at Arundell Street, Haymarket, 16.66. Imperial gas, at Chelsea, 16.29; at Camden Town, 15.68. South Metropolitan gas at Peckham, 15.90. The average quality of the Cannel gas has been 25.87 candles in the case of the City Company's gas, and 25.07 in that of the Chartered Company. As regards impurities, Dr. Letheby reports that the gas of all the companies has been constantly free from sulphuretted hydrogen, but that the amount of sulphur in other form than this has fluctuated to a very large extent, for while the average amount of this impurity was only 13.28 grains per 100 cubic feet of the City Company's Cannel gas, it amounted to 34.69 grains per cubic feet of the South Metropolitan gas. The average proportion of sulphur in the gas of each of the companies during

the quarter was as follows:—City Company's Cannel gas, 13.28 grains per 100 cubic feet; common gas, 21.84 grains. Great Central gas, 21.19 grains. Chartered gas, at Leadenhall Street, 22.97 grains; at Gray's Inn Lane, 27.87 grains; at Arundell Street, 28.45 grains. Imperial gas at Chelsea, 30.35 grains; at Camden Town, 24.03 grains. South Metropolitan, 34.69 grains. According to Dr. Letheby, these large differences are entirely due to the different processes of manufacture and purification, and they indicate the means of reducing this serious impurity to the smallest amount. Ammonia has not been present in excessive quantity in the gas of any of the companies except the Chartered, and it was only in excess in the gas of that company on the several days from the 12th to the 25th of July last, when it arose from accidental circumstances over which the company had no control.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

*Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

*Annalen der Chemie und Pharmacie*, September, 1870.

This number contains the following original papers and essays:—

**On Euxanthon and on Euxanthinic Acid.**—A. Baeyer.—The author begins this lengthy memoir with an introduction on the employment of metallic zinc-dust for the purpose of withdrawing oxygen from aromatic compounds, and replacing it by hydrogen. Next, the statement is made that the nature and true constitution of euxanthon, first submitted to research by Dr. Stenhouse and the late Dr. Erdmann, is as yet very obscure. (Euxanthinic acid is a substance present in purrhee, Indian yellow; euxanthon is a derivative of that acid.) The author afterwards describes, at very great length, a series of experiments made with the view to elucidate the constitution, first, of euxanthon, which yields, when fused with caustic potassa, a new body,  $C_{13}H_{10}O_6$ , euxanthonic acid, distinguished from euxanthon by its far greater solubility in water, from which it crystallises readily. The formula of euxanthon, as originally put forward by Dr. Stenhouse—viz.,  $C_{13}H_8O_4$ —is considered by the author as true and correct, and also agrees with the products of substitution of euxanthon. A second portion of this memoir is devoted to euxanthinic acid, about which we meet with a lengthy discussion regarding the value of the formulæ assigned to this substance by various authors. According to the late Dr. Gerhardt, the formula of this substance is  $C_{42}H_{18}O_{22}$ ; but, from a series of experiments, and from the substitution compounds of this acid, the author deduces the formula  $C_{19}H_{16}O_{10}$ .

**Reduction of Aromatic Hydrocarbons by means of Iodphosphonium.**—A. Baeyer.—This lengthy essay begins with a brief review of reduction experiments in general. Next, we meet with a description of a process for the preparation of iodphosphonium:—Dry sulphide of carbon is poured into a tabulated retort, and 100 grms. of phosphorus are dissolved in this liquid, to which, while kept very cold, are added gradually, and in small quantities at a time, 175 grms. of iodine. The sulphide of carbon is next driven off by gentle distillation, and the last traces of that liquid are removed by a current of dry carbonic acid gas, the retort being gently warmed all the while. When this operation has been finished, and the retort has cooled down, there is adapted to the retort, instead of the cooling tube, a rather wide tube, to which is fastened a gas-conducting tube, which ends in a bottle partly filled with water; but the tube should not touch that liquid. This having been done, there is placed in the tubulus of the retort, a funnel, the neck of which is drawn out into a long, narrow point. Through this funnel, a quantity of 50 grms. of water is gradually poured, by small portions at a time (this operation requires great care, since it may readily lead to very serious explosions). After all the water has been added, the retort is heated, at first gently, and at last to dull red heat, whereby the iodphosphonium is driven into the wide tube above spoken of. It condenses in the same, exhibiting a solid body resembling sal-ammoniac. The reaction described is expressed by  $P_2I + 2H_2O = PH_4I + PO_2$ . The author further enters into exhaustive details on the best methods of making iodphosphonium react upon hydrocarbons, and the action of the former body upon benzol, toluol, xylol, mesitylen, naphthaline, and oil of turpentine is described at length.

**Researches on the Bases of the Pyridine and Chinolin Series.**—A. Bayer.—This monograph is divided into the following



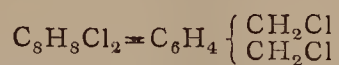
sections:—Synthesis of picoline; preparation of picoline from acroleine ammonia; picoline from tribromallyl.

**Aldehyde-Collidine.**—E. Ador and A. Bayer.—This paper is really an integral portion of the preceding, but is in the original text under a separate title. Aldehyde-collidine is a body akin to the collidine obtained from Dippel's oil by Dr. Anderson. The authors have divided this paper into the undermentioned sections:—Action of iodethyl upon collidine; by-products of the preparation of collidine.

**On Cinchonin-Chinoline.**—N. Lubavin.—The author treats on—Sulpho-chinolinic acid,  $C_9H_7NSO_3$ ; tribrom-chinoline. It appears, from the author's researches, that chinoline belongs to the same series of bases as picoline and pyridine; but Dr. Bayer adds, at the end of this paper, that the true constitution of these bodies is as yet undetermined.

**Vapour Densities of Acetic Acid.**—A. Naumann.—This exhaustive monograph contains, in the tabulated form, the record of the following experiments:—Vapour densities at  $78^\circ$ ,  $100^\circ$ ,  $110^\circ$ ,  $120^\circ$ ,  $130^\circ$ ,  $140^\circ$ ,  $150^\circ$ ,  $160^\circ$ , and  $185^\circ$ ; vapour densities of acetic acid for equal quantities of acetic acid in the unit of fluid measure; equal vapour densities of acetic acid for variable temperatures and pressures.

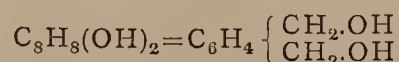
**Aromatic Glycol.**—E. Grimaux.—The author describes—Tollylen-chloride—



tollylen-bromide,  $C_8H_8Br_2$ ; tollylen-iodide,  $C_8H_8I_2$ ; monobenzoic acid tollylen-ether—



deuto-acetic acid tollyl-ether,  $C_{12}H_{14}O_4 = C_8H_8(C_2H_3O_2)_2$ ; tollylen-glycol—



**The Water of the Nile.**—O. Popp.—The author states that, while staying in Egypt on a visit, he was requested by a Turkish prince, Halim by name, to make an analysis of the water of this celebrated river, the private chemical laboratory of the prince being placed at his disposal for this purpose. The author's paper opens with some particulars respecting the river Nile, which, from its source to its mouths (there are several), has a direct course of 4200 kilometres, by an average width of from 300 to 400 metres. The mean average temperature of the water of the Nile is only  $2^\circ$  or  $3^\circ$  below the average mean temperature of the air of Egypt. The sample of water taken for analysis was obtained from the middle of the river, some 6 miles below Cairo. Previous to being analysed, the water was left standing for two days, after which time the water was first filtered; but, even after this operation, it did not become quite clear, and it was found necessary, consequently, to leave it standing for some few days longer, when it deposited a flocculent sediment, which, on being tested, was found to consist of silica, a minute quantity of organic matter, lime, and magnesia salts. One litre of the water contains, in grammes weight—Carbonic acid, 0.03146; sulphuric acid, 0.00390; silica, 0.02010; phosphoric acid, 0.00054; chlorine, 0.00337; peroxide of iron, 0.00316; lime, 0.02220; magnesia, 0.01467; soda, 0.02110; potassa, 0.00468; organic matter, 0.01720;—total, 0.14238 grm. Percentage composition of dry residue—Carbonic acid, 22.155; sulphuric acid, 2.755; silica, 14.150; phosphoric acid, 0.379; chlorine, 2.372; peroxide of iron, 2.227; lime, 15.640; magnesia, 10.332; soda, 14.852; potassa, 3.300; organic matter and small quantity of ammoniacal salts, 12.025;—total, 100.187. Taking into consideration that the quantity of water annually carried by the Nile to sea amounts to 55,000,000,000 of cubic metres (equal to as many tons), some idea can be formed of the quantity of salts, &c., poured by this river into the Mediterranean. The author also analysed the mud and slime deposited from the water of the river; the composition of a sample taken at Soudan was, per centically—Peroxide of iron, 11.95; organic matter, 14.85; lime, 2.64; magnesia, 1.85; soluble silica, 5.50; clay and water, 62.3.

**Egyptian Trona.**—O. Popp.—The substance known as trona (also named nitrum, although it does not contain even a trace of nitric acid or nitrates) is a native saline produce, a sample of which yielded, on analysis, per centically—Carbonic acid, 33.15; sulphuric acid, 1.65; chlorine, 5.11; soda, 36.34; lime, 0.55; water, 22.50; insoluble matter, 1.65. Equal to—Sesquicarbonate of soda, 64.3; sulphate of soda, 1.5; chloride of sodium, 8.4; sulphate of lime, 1.3; water, 22.5; insoluble matter, 1.65.

**Composition of the Excrements of Egyptian Bats.**—O. Popp.—After referring to the curious fact that Egypt, owing to its very clear sky at nights, and its sub-tropical climate, is especially suited for bats, of which no less than eight different *genera* are found there, the author proceeds to detail the methods of analysis at length; the result of the composition of the excrements, in 100 parts, being—Urea, 77.80; uric acid, 1.25; kreatine, 2.55; phosphate of soda ( $2NaO, HO, PO_5$ ), 13.45; water driven off at  $100^\circ$ , 3.66; substances insoluble in water, 0.575;—total, 99.285. In a foot-note to this paper, Dr. F. Wöhler states that very recently the excrements of bats from Egypt have become an article of trade, as a sort of guano for manure purposes.

**On Ccollpa.**—F. Schickendantz.—By the name at the heading is understood (the pronunciation is koichpa) a saline efflorescence, not unfrequently met with in certain parts of the slopes and along the rivers originating in the Cordilleras de los Andes. The author gives, at great length, details of the analysis of several samples of this substance, which, setting aside impurities present only in small quantity, consists, in 100 parts, of—Soda, 45.21; carbonic acid, 28.99; water, 25.70; agreeing nearly with the formula  $Na_2C_2O_3 + 2H_2O$ . Another sample consisted mainly of—Water, 35.28; soda, 38.28; carbonic acid, 26.44; nearly agreeing with the formula  $Na_2C_2O_3 + 3H_2O$ . The author resides at Pilciao, province of Catamarca, Argentine Republic.

*Zeitschrift für Chemie von Beilstein*, No. 14, 1870.

This number contains the following original papers:—

**Ortho-Nitrotoluol.**—F. Beilstein and A. Kuhlberg.—The authors describe—Nitrited aceto-metatoluidine, obtained by treating aceto-metatoluidine with a mixture of 2 parts, by bulk, of very strong fuming nitric acid (the so-called *acidum nitroso-nitricum*), and 1 part, by bulk, of strong nitric acid (sp. gr., 1.475). The product thus obtained is a solid, crystalline body, insoluble in water, soluble in alcohol, and fusing at about  $197^\circ$ . Ortho-nitro-metatoluidine,  $C_6H_5(NO_2)O(NH_2)m, CH_3$ , prepared from the preceding compound by decomposing it by means of dilute sulphuric acid or alcoholic solution of potassa; a solid yellow-coloured crystalline substance, soluble in alcohol, fusing at about  $128^\circ$ , and yielding no salts with acids.

**Chlorinated Para-Chlorobenzoic Acid.**—F. Beilstein and A. Kuhlberg.—*p*-chlorobenzoic acid was treated in a sealed tube, at  $200^\circ$ , with 4 molecules of  $SbCl_5$ ; and, after purification of the newly-formed substance, the authors found that the result of the reaction was the formation of di-chlorobenzoic acid.

**On Xylol.**—N. Tawildarow.—The author describes— $\beta$  nitro-xylol; boils at from  $237^\circ$  to  $239^\circ$ ; fuses at  $2^\circ$ ; sp. gr. at  $17.5^\circ$ , 1.126.  $\beta$  xylidine, and the oxalate of that base, of which latter salt 100 parts of water at  $18^\circ$  dissolve 3.319 parts. An acetyl derivative,  $C_8H_9.NH(C_2H_3O)$ , from  $\alpha$  xylidine, fuses at  $123^\circ$ , boils at  $310^\circ$ , and is very difficultly soluble in water. When crude xylol is treated with nitric acid, a series of nitro acids are formed; one among these yielded a barium salt,  $(C_8H_7O_2)_2Ba + 2H_2O$ —that is to say, a new modification of toluylic acid, which the author calls pseudo-toluylic acid.

**Combination of Ethylen with the Bromides of Iron and Platinum.**—C. Chojnacki.—The author gives, at great length, an account of the experiments by which he succeeded in preparing compounds of ethylen with iron and bromine, and also of the ethylen with platinum and bromine. The former combination,  $C_2H_4.FeBr_2 + 2H_2O$ , contains, in 100 parts, 20 parts of iron, 57 of bromine, and 13 of water. The formula of the platinum combination is  $C_2H_4.PtBr_2KBr + H_2O$ .

**Researches on Sorbinic Acid, and on so-called Para-Sorbinic Acid.**—J. Barringer and R. Fittig.—This lengthy memoir is divided into the following sections:—Action of hydrogen upon sorbinic acid, yielding hydro-sorbinic acid,  $C_6H_{10}O_2$ , a colourless, peculiar smelling liquid; sp. gr. at  $19^\circ$ , 0.969; boils at  $204.5^\circ$ ; is not solidified at  $-18^\circ$ . Several of the salts of this acid are described. Action of bromine upon sorbinic acid.

**Conversion of Piperonylic Acid into Protocatechutic Acid.**—J. Remsen and R. Fittig.—This paper is chiefly a series of lengthy and complicated formulæ.

**Contribution to Our Knowledge on Oil of Rue.**—A. Giesecke.—The author of this memoir first refers at some length to the labours of a large number of chemists on this subject. He next relates a series of his own experiments chiefly made with the view to settle the question regarding the true chemical nature of oil of rue, which some consider to be a methyl-caprinol,  $C_9H_{19}-CO-CH_3$ . This view is confirmed by the author, who, moreover, has gone more deeply into this subject, treating on the action of nascent hydrogen on oil of rue, and the action of pentachloride of phosphorus on this substance.

*Jahrbuch der Kaiserlich-Königlichen Geologischen Reichsanstalt*, No. 2, 1870.

This number contains the following original papers relating to chemistry and collateral sciences:—

**Contribution to Our Knowledge on the Dyas and Coal Formation in the Banate.**—D. Stur.—The meaning of dyas is sometimes, and more usually, expressed by Permian; this latter term is derived from Perm, a large district of Russia, which is characterised by a peculiar formation of rocks. The contents of this paper chiefly relate to phuto-paleology—that is to say, a description of extinct plants found in the formations alluded to, situated in the Banate, a large district of Hungary.

**Geological Studies Concerning the Orient.**—F. Chevalier von Andrian.—This paper contains the detailed mineralogical description of various minerals composing the volcanic rocks bordering on the Bosphorus. The following chemical analyses made by M. Karl Ritter von Hauer, are quoted in this memoir:—Andesite, in 100 parts—Silica, 63.87; alumina, 15.76; protoxide of iron, 5.43; lime, 3.66; magnesia, 1.06; potassa, 3.33; soda, 3.59; loss by ignition, 2.05;—total, 98.75. Greenstone, in 100 parts—Silica, 55.53; alumina, 13.81; protoxide of iron, 6.74; peroxide of iron, 4.45; protoxide of manganese, a trace; lime, 4.13; magnesia, 2.41; potassa, 3.64; soda, 3.26; loss by heat, sulphuric and carbonic acids, and water, together, 6.38;—total, 100.35.

**Trinkerite, a Newly-Discovered Fossil Resin.**—Dr. G. Tschermak.—The author states that the resin alluded to is found in compact masses in the braunkohle formation, near Carpano and Albona, in Istria. The resin is brittle; its colour varies from hyacinth red to chestnut brown. The mineral exhibits a fatty gloss; is transparent; its fracture plano-conchoidal; sp. gr., 1.025; becomes highly electric when rubbed; gives off, on being gently heated, and also while being pulverised, an aromatic pleasant odour; its melting-point varies from  $168^\circ$  to  $180^\circ$ . When fused, the substance gives off a nasty pungent smell; and, when the molten mass begins to boil, vapours are given off, which, when carried into solutions of lead or copper salts, cause a black precipitate therein. This resin was chemically investigated by Professor Hlasiwetz, the result of whose research is as follows:—The substance is hardly soluble in alcohol or ether, but is perfectly soluble in boiling benzol; heated in a retort, it melts, begins to boil, then gives off sulphuretted hydrogen gas, and yields an oily distillate. The



elementary analysis led to the following percentage result:—Carbon, 81.1; hydrogen, 11.2; sulphur, 4.7; oxygen, 3.0; no ash. When treated with fusing caustic potassa, the resin is oxidised; but the products of this reaction did not yield anything specific. The resin appears to belong to the substances akin to copal; but the fact that it contains sulphur is peculiar, since as yet no other fossil-resin containing sulphur is known, except the tasmanite described by Dr. Church (*Phil. Mag.*, vol. xxviii., 1864, p. 465). The name of trinkerite has been given to the substance alluded to in order to commemorate the discoverer, M. J. Trinker, geologist at Laibach. Although the composition of tasmanite (viz.—carbon, 79.34; hydrogen, 10.41; sulphur, 5.32; oxygen, 4.93) is very nearly the same as the mineral just mentioned, the tasmanite is intimately mixed with from 60 to 70 per cent of clay (deducted, of course, in the analysis just quoted); and tasmanite, moreover, is altogether insoluble in benzol, Dr. Hlasiwetz having purposely tested this reaction with a specimen of tasmanite kept in the Imperial Mineralogical Museum at Vienna.

*Bayerisches Industrie und Gewerbe Blatt*, July, 1870.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

**Production of Cold by Mechanical Means.**—C. Linde.—This lengthy memoir, illustrated by geometrical figures and a series of algebraical formulæ, treats chiefly on the question of the amount of force to be applied in order to obtain the withdrawal of a certain amount of heat at a given temperature.

**Description of an Apparatus for the Manufacture of Gas from Petroleum and from Residues left by the Distillation of that Liquid.**—L. A. Riedinger.—This paper, illustrated by a series of exceedingly beautiful lithographs, contains the description of a well-arranged apparatus to produce gas from crude petroleum, or from the residues of its distillation. That industry has become rapidly developed on the Continent, as well as in the United States of America; and it is a wonder that it is not thought of in this country, the gas thus produced being far superior to coal-gas. The apparatus here alluded to is only contrived for use on a comparatively small scale (for 300 lights), but in many parts of Switzerland and Germany towns and villages are cheaply and effectually supplied with petroleum gas.

*Revue des Cours Scientifiques de la France et de l'Etranger*,  
September 10, 1870.

This number does not contain any paper or memoir relating to chemistry or physical sciences, but it opens with a brief and modest eulogium on M. Jules Simon, the new Minister of Public Instruction, reminding, at the same time, that this gentleman was, on December 2nd, 1851, the most influential of the Professors of the Sorbonne, and a man who, in every respect, is eminently fit to be the head of the important public department just named.

*Journal für Gasbeleuchtung*, August, 1870.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

**Report of the Proceedings of the Tenth Annual Meeting of the Gas Engineers and Gas Works' Managers in Germany, held at Hamburg in the month of May last.**—Dr. N. Schilling.—This report contains the following sections:—A paper on the establishment of an experimental gas work, to be constructed with the view of testing coals and making experiments on various matters of practical interest, the works to be the property of the Association. The experiments intended to be made are:—The accurate determination of the quantity of gas made from a given weight of coals after complete purification of the gas from sulphuretted hydrogen, ammonia, and carbonic acid. Determination of the specific gravity of the gas by the method of the velocity of efflux, as compared with atmospheric air; quantitative estimation of the heavy hydrocarbons contained in the gas, by means of absorption in the eudiometer; estimation of the illuminating power, according to a plan fully detailed by a sub-committee of the Association; estimation of the quantity of coke, by weight as well as by measure, care being taken to extinguish this material, when taken from the red-hot retorts, in a peculiar manner, without contact of air; estimation of the value of the coke as fuel; estimation of the value of the tar, and of the ammoniacal liquor, for various purposes.

**Detection of Sulphur in Coal-Gas.**—M. Ulex.—The author says—The presence of sulphur in coal-gas can be proved in the following simple manner:—Let a platinum basin be filled with half a litre of water, and the basin be heated over a Bunsen burner until all the liquid has evaporated; the basin will be found to be coated, on the outside, where it has been struck by the flame, with a dirty, greasy looking substance, which, on being washed off with pure distilled water, and tested, proves to be sulphuric acid. The author further points out that the glass chimneys used with Argand gas-burners soon become coated over internally with a white substance, which, on being washed off with distilled water, will be found to be, on testing, sulphate of ammonia. The glass panes of a room wherein gas is burned for a few evenings consecutively will, when rubbed with the fingers of a clean hand, impart to it a substance which, on the hand being rinsed in distilled water, will yield a precipitate of sulphate of baryta with chloride of barium, and a brick-red precipitate with potassio-iodide of mercury.

September, 1870.

The original papers contained in this number do not, strictly speaking, relate to chemistry, but the titles of those which are of a more general practical interest are:—

**Drainage considered in its bearing upon the Water Supply.**—H. Speck.—This memoir contains some very interesting matters as regards the drainage of arable land and meadows, and the bearing thereof upon water supply.

**Description of the Water-Works constructed in 1868 for the Supply of Good Potable Water to the City of Berne (Switzerland).**—M. Rothenbach.—Illustrated with woodcuts.

**Instructions, Rules, and Regulations concerning the Use of Gas and the Inspection of Gas-Works, Gas-Meters, and Gas-Pipes ordered to be observed by the Communal Authorities of Karlsruhe (Baden).**—This paper is an excellent and brief epitome of, and guide for, gas managers, gas engineers, meter-makers, and gasfitters. It is a proof of the very great superiority of the technical instruction so generally spread over Germany; because, without sound knowledge no workmen could either understand or carry into effect what is here ordered to be done in the general interest of the whole community.

*Pharmaceutische Zeitschrift für Russland*, No. 1, 1870.

Since the beginning of this year this periodical has been published fortnightly, instead of monthly as before, but we have only just now received a portion of what has been published. The first number contains the following original papers and memoirs:—

**Researches on the Fermentable Matter (Ferment Substanzen) contained in the Water of the River Newa, and in that of the Canals of St. Petersburg.**—Drs. A. and F. Lösch.—This lengthy memoir contains the results of a series of experiments made with the view to ascertain, quantitatively, the presence of fermentable (that is, in this instance, "disease generating") matter which occurs in the waters above alluded to. The authors have, for this purpose, applied Schönbein's test, whereby the property of fermentable substances to decompose water is applied to the detection of the presence of these substances; while, moreover, the authors employed, for comparison's sake, a very weak solution of pure emulsine. The main result of these researches is chiefly of local importance to St. Petersburg only; but we learn that, while the water of the river Newa, even at the time of high floods, is comparatively very pure, and absolutely so in its normal state, the water of some of the canals contains a considerable quantity of fermentable matter.

No. 2.

**On Ricinine and the Active Principle of Ricinus Seeds.**—E. Werner.—After referring, at length, to Dr. Tuson's researches on this subject, the author describes a series of experiments, chiefly made with the view to obtain, from the ricinus seeds, an active principle suitable for medicinal use. As regards the ricinine of Dr. Tuson, prepared by the author in large quantity and according to Dr. Tuson's directions, it is stated that ricinine is not an alkaloid, and, moreover, a substance which contains a considerable quantity of ash; and the author, after carefully made analysis, comes to the conclusion that Dr. Tuson's ricinine is a compound of magnesia and of an organic acid, the formula of this body being  $C_{11}H_{20}O_{10}Mg_2 + 6H_2O$ .

**Japanese Firework Mixture.**—O. Görke.—The author recommends the following mixture:—Finely-pulverised nitrate of potassa, 70 parts; washed flowers of sulphur, 30 parts; *pulveris lycopodii*, 12 parts; best and very light lamp-black, 8 parts. From  $1\frac{1}{2}$  to 2 grains of this powder are sufficient for use packed in strips of suitable paper.

**Occurrence of Naphtha and Ozokerite in Europe and Asia.**—Dr. G. A. Björklund.—This lengthy memoir gives a detailed account of the enormous wealth of the Russian Empire as regards inexhaustible sources of naphtha and ozokerite, which latter is actually obtained by mining and quarrying in large quantities, and applied to the manufacture of paraffin, and, in some instances for the adulteration of bees'-wax.

No. 3.

**Description of Various Pharmacognostic Substances met with in Central Asia.**—Dr. R. Palm.—The author, a pharmacist residing at Taschkend (a large town situated at 43° 3' N. lat., and at about 68° E. of Greenwich), describes at length, and in a tabular form, a series of substances, a large number of which are known in Europe, but many being altogether unknown there even by name. As instances, we mention—*Baladür*.—A drug somewhat akin in shape, size, and colour to large plums, but containing an oily fluid, and also a seed somewhat akin to the kernel of the almond; this drug is used as a dye material. *Scharüm-Dorü*.—The dried leaves of an unknown plant containing a large proportion of bromides and iodides, and yielding, with water, a thick mucilage; this leaf is imported from China. *Iriana*.—Small bitter-tasted seeds, containing a peculiar essential oil. *Akir-kara*.—A dry root imported from China, and very highly prized and expensive; is used as anti-scorbutic. *Kapnarz*.—A dirty violet-grey coloured powder; taste, strongly astringent; is used as a dye-stuff for producing black with sulphate of iron. *Scharatsch*.—A powder similar in appearance to rye-meal; it is used, after having been mixed with water, as paste, but also as cattle fodder, and is apparently the powder of an orchideous root. We cannot continue this lengthy catalogue; but it appears, from its contents, that the inhabitants of the Khokand are a far more civilised, and, also, industrially-developed, people than would appear to Europeans to be the case. Indeed, the



author of this paper states that these Tartars are acquainted, not only with drugs, dye-stuffs, and other substances entirely unknown in Europe, but also with industrial processes with which Europeans are not acquainted.

## NOTES AND QUERIES.

**Black Japan.**—I shall be glad if you can tell me how to make the black Japan that is used for coach work.—S. R. H.

**Anthracene.**—Will any reader of your valuable journal, inform me if there is any market for artificial anthracene, and what the price is?—H. J.

**Hofmann's Violet.**—(Reply to "Querist.")—You will find the reply to some, if not to all, of your queries in the work "On Aniline and its Derivatives," published by Longmans and Co., 1868.

**Estimating Cyanides.**—I should be glad of the best method of estimating the cyanides in brown sulphate of ammonia: the methods in the ordinary text-books not being found satisfactory.—E. OUTHET.

**Manufacture of Sulphuric Acid.**—(Reply to "A Manufacturer.") In all probability the process you refer to is that of P. W. Hofmann, described in CHEMICAL NEWS, vol. xxi., p. 106, and also referred to in the same volume, p. 164.

**Carbonic Ether.**—(Reply to H. S.)—You will not be likely to buy this compound. According to the account given thereupon in the latest edition of the late Dr. W. A. Miller's work, "Elements of Chemistry," vol. iii., p. 225, it can be formed by heating argentic carbonate with iodide of ethyl, in a closed tube; but it is generally procured by heating sodium or potassium with oxalic ether.

**Bleaching Wax.**—(Reply to F. C. Terrell.)—The bleaching of bees'-wax and paraffin-wax (which is simply paraffin) cannot be effected by one and the same process. As regards the bleaching of bees'-wax, the description of that process is far too lengthy to be here detailed even in brief outline, and you had best consult on that subject Ure's "Dictionary of Arts, &c.," 6th edition, vol. iii., p. 1040. The same observation applies to paraffin, on which you will find an excellent article in the work just quoted, same vol., pp. 360 to 371.

**Drying Oil.**—(Reply to R.)—You wish for a good drying linseed oil, prepared without heat, by which is really understood that it be rendered drying without the usual process of boiling. Mix with old linseed oil, the older you can get it the better, 2 percent of its weight of manganese borate (this salt is readily prepared by precipitating a solution of sulphate of manganese with a solution of borax, wash the precipitate, and dry it either at the ordinary temperature of the air or at 100°), and heat this mixture on a water-bath, or, if you have to work with large quantities, with a steam-bath to 100°, or at most 110°; you thus obtain a very excellent, light-coloured, rapidly-drying oil; by keeping the mixture stirred, that is to say, by always exposing fresh portions to air, the drying property of the oil is greatly promoted. The rapidity of the drying of the oil after it has been mixed with paint, on surfaces besmeared therewith, does not simply depend upon the drying property of the oil, but, in a very great measure, upon the state of the atmosphere—viz., whether dry or moist, hot or cold—the direct action of sunlight, and the state of the surfaces on which the paint is brought. Really genuine boiled linseed oil, if well prepared, leaves nothing to be desired as regards rapidity of drying, but it is retarded by various substances which are added in practice, among which, especially, oil of turpentine is injurious.

**Hard and Soft Water.**—(Reply to "Sanitas.")—Soft water does not necessarily imply rain-water; for instance, the waters supplied to Glasgow and Edinburgh are soft, and not, therefore, rain-water, in the sense you take it. The water supplied to the Metropolis becomes considerably softened by ebullition, on account of the precipitation of the carbonate of lime held in solution by carbonic acid, which escapes during the boiling. As regards drinking, we are inclined to think that, generally speaking, cold water is not too much used in the Metropolis, and what is used for that purpose is sufficiently soft and pure; indeed, the water supplied to some other towns of this country—e.g., Sunderland and South Shields—although very much harder than London water, is pleasanter and more refreshing to drink, on account of the far larger quantity of free carbonic acid contained in the water pumped up from deep wells bored into the rock. In many parts of Germany, especially in the province of Nassau, all spring water in ordinary use has a somewhat mineral taste, but its use does not injuriously affect the health of the inhabitants. The very pure water of the Rhine is not, in Germany at least, used for drinking or culinary purposes, unless by the shippers and crews of steamers and other vessels navigating that river.

## TO CORRESPONDENTS.

**J. Farie.**—(1.) We know of no recent Chemical Catechism. (2.) Roscoe's "Elementary Chemistry."

**R.**—Hardwich's "Photographic Chemistry," or Lake Price's work.

**T. J. F.**—Both your communications have been received.

**R. Heaton.**—Received; thanks.

**A. E. J.**—The subject is a metaphysical one, which it would be a waste of time to discuss.

**R. E. Bibby.**—You will probably get aureoline at Winsor and Newton's, Rathbone Place, W.

**R. H. and Sons.**—The work will not be ready yet.

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# THE CHEMICAL NEWS.

VOL. XXII. No. 570.

## SOLAR SPECTROMETRY.

REFERRING to Professor Young's spectroscopic notes published in our last issue, Mr. J. Norman Lockyer, F.R.S., writes to remind us that he saw sodium and magnesium prominences bright over sun spots a long time ago. The following appears in No. 5 of his "Spectroscopic Observations of the Sun," published in *Proceedings of the Royal Society*, No. 115, 1869, page 74:—

"Bright prominences, when seen above spots on the disk, if built up of other substances besides hydrogen, are indicated by the bright lines of these substances in addition to the lines of hydrogen. The bright lines are then seen very thin, situated centrally (or nearly so) on the broad absorption-bands caused by the underlying less-luminous vapours of the same substances."

## NOTES ON A PROCESS FOR THE PRESERVATION OF BUILDING-STONES.\*

By A. H. CHURCH, M.A.

My attention was directed to the subject of the preservation of stone about 1860. In 1862 I took out a patent for this purpose. The process consisted in the alternate application of solutions of pure baryta and pure (dialysed) silica. The plan was partially successful, and possessed the great advantage of causing no discolouration or efflorescence on the stone. But the solutions were rather weak, and, therefore, many repetitions of the process were necessary to secure an effective protection. Then, too, the silica solution failed to penetrate calcareous stone to any appreciable depth, owing to its rapid coagulation. After some years of further experiment, improvements were devised which ultimately resulted in a new and much more successful process. This process, for which a patent was obtained, in 1869, by Ransome's Patent Stone Company, consists in the successive and repeated application of three liquids. The first of these is a solution of mono-calcic phosphate, often erroneously termed biphosphate of lime, and first introduced, I believe, for a similar purpose, by Coignet. The second solution is one of barium-hydrate, applied warm if possible; and the third is a dialysed solution of silica, to which small quantities of the ordinary potassium and sodium silicates of commerce have been subsequently added.

It will not be necessary to dwell upon the proper methods of applying these solutions, nor upon the details of their manufacture. I may, however, mention that there is no difficulty in obtaining the various solutions in a state of sufficient purity and strength, and at a sufficiently low rate, to admit of their economical employment for the purpose in view. And it may be interesting to state that the dialysers employed, which are of the capacity of 6 gallons or more, and of an open bell shape, are found capable of doing their work very successfully when floated on or suspended in barrels of rain-water, or on rafts in a tank or pond; the movement of water below the diaphragm of vegetable parchment increases remarkably the rate of separation.

The reactions which take place between the several solutions themselves and between the solution and the constituents of the objects treated cannot be described in detail. The mono-calcic phosphate becomes

chiefly di-calcic phosphate in contact with a limestone, and then, on the application of baryta, a barium di-calcic phosphate is formed. If decay has already taken place, and sulphates have been formed in the stone, these are converted into insoluble and non-efflorescent barium sulphate, while the lime and magnesia thus liberated immediately become phosphated by the subsequent application of the mono-calcic phosphate solution. The siliceous solution finally employed keeps good some time, and penetrates some distance beneath the surface. It contains, indeed, a small quantity of alkalies, but their amount is not sufficient to produce any soluble salts in the treated stone or bricks. It would be tedious to enter into the proofs of this statement furnished by direct experiment. Extensive trials of the new process have been made on many important buildings, some of which have been entirely treated by the three solutions described above. I may cite as examples of the use of the process, the Chapter House at Westminster, and the St. Pancras Midland Terminus; portions of Canterbury Cathedral have also been submitted to treatment, together with numerous other buildings, public and private. Where the direction has been carried out with fidelity the results have invariably promised well. No marked alteration of the appearance of the stone is to be seen after the lapse of a few months from the time of using the process. The waterproofing of the stone effected by the use of the solutions is seen in many ways, particularly when after a shower of rain the colour of the treated surfaces is seen not to be darkened by absorption of water. A piece of black cloth drawn over a piece of Bath or Caen stone after treatment neither blackens the stone nor is itself whitened by it.

I may add, in concluding this very imperfect notice, that my process is one of those just selected (1870) for the renewed trial at the Houses of Parliament. The specimens exhibited are treated and un-treated specimens of the chief stones employed at the Chapter House, Westminster, and at the St. Pancras Terminus.

## ON THE MAXIMUM OF MAGNETIC POWER EVOLVED BY A GALVANIC BATTERY.\*

By the Rev. H. HIGHTON, M.A.

IN trying experiments on this subject, the author found that the magnetic power evolved by a given battery could be increased without limit. This was the case both in theory and practice.

Thus, if  $F$  = magnetic force of current in a unit of length of wire,  $E$  = electro-motive power,  $R(b)$  = resistance of battery,  $r(w)$  = specific resistance of wire,  $l$  = length of wire,  $s$  = section of wire—

$$F = \frac{E}{R(b) + r(w)\frac{l}{s}}$$

And if  $M$  = total magnetic force in the whole length of wire—

$$M = F \times l = \frac{El}{R(b) + r(w)\frac{l}{s}}$$

But if the length and section of the wire be increased in proportion,  $l$  becoming  $nl$  and  $s$  becoming  $ns$ , the equation becomes—

$$M = \frac{Enl}{R(b) + r(w)\frac{nl}{ns}} = \frac{Enl}{R(b) + r(w)\frac{l}{s}}$$

In other words, by simply increasing the length and section

\* Read before the British Association, Liverpool Meeting, Section B.

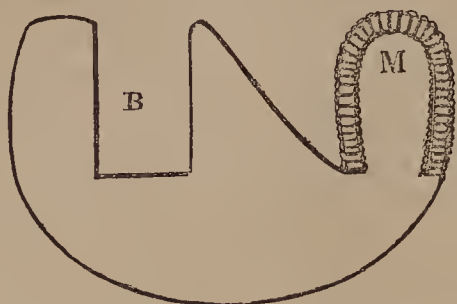
\* Abstract of a paper read before the British Association, Liverpool Meeting, Section A.



of the wire, the magnetic power may be increased without limit.

The experiment may be tried as follows:—

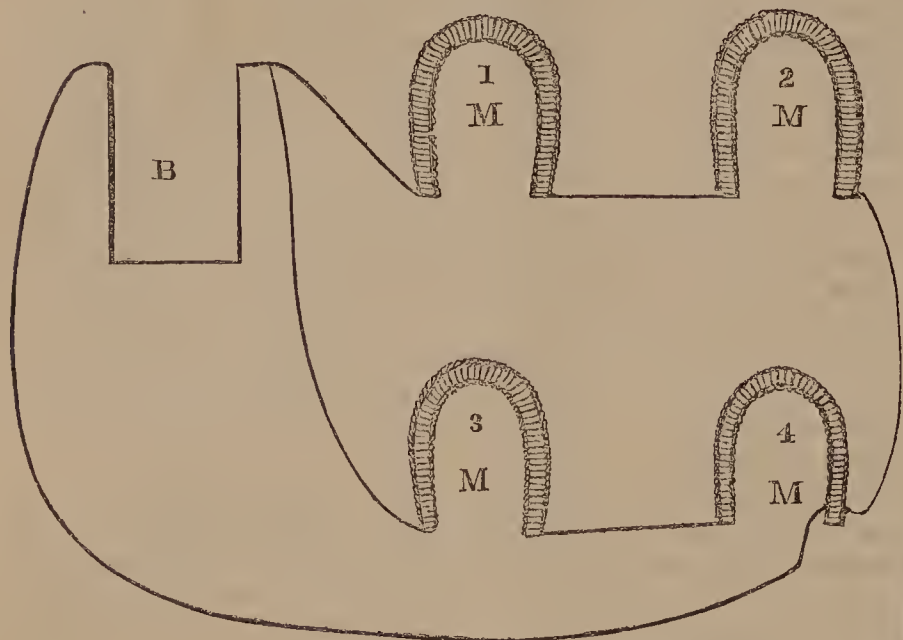
FIG. 1.



Let B be a galvanic battery, and  $m$  an electro-magnet supporting a weight of  $n$  lbs.

Change the arrangement as follows:—

FIG. 2.



Let B be the same battery, and  $m, m, m, m$ , be four electro-magnets exactly similar to the former one. Let half the current go through the magnets  $m$  and  $m$ , and the other half through  $m$  and  $m$ ; then it will be found that each magnet sustains  $\frac{n}{2}$  lbs., or the whole four will bear  $2n$  lbs., or twice the weight sustained before.

And the same process may be repeated or varied *ad infinitum*. Can we then get infinite power out of a finite source of force? Yes; but, on this condition, that what we gain in power we lose in time; for the current would take twice as long to traverse the second circuit, and, therefore, it takes double the time to produce double the magnetic power. But the electric current is so rapid that this difference of time is inappreciable within any practical limits.

It may be said that in this arrangement we are doing no work. This is so far true, that we are only doing work while the soft iron is being magnetised, and pressing the iron keeper to itself. But this work is being done every time that the circuit, after being broken, is closed; and the circuit may be broken and closed so many times a second that the number is practically illimitable, and hence the amount of work which can be done by a given battery is illimitable. The only question is a question of first cost of machinery.

What becomes of the electric power in the interval between the moment when the soft wire becomes fully magnetised, and the moment when the circuit is broken? It is wasted in producing heat in the wire,\* and the smaller this waste the greater the available magnetic power.

All the relations given in our text-books between amounts of electrolysis, electric force, heat, and motion,

\* Since writing the above, I have found strong reasons for doubting the truth of this statement; but I propose shortly publishing a full discussion of this point.—H. H.

are true only partially and in particular cases. The author hopes, at some future time, to show how far they are true, and where they fail.

According to Joule, Favre, Silbermann, and others, the consumption of a gramme of zinc in a battery produces about 550 units of heat (each unit being able to raise about 423 grammes through 1 metre), or = about 232,650 grammes raised 1 metre. But Faraday said a grain of zinc produces more force than any flash of lightning; and Weber and Kohlrausch say that the force which decomposes 9 milligrammes of water—that is, *the force of oxidation of 1 milligramme of hydrogen, can raise 208 tons 1000 metres!* and a gramme of zinc will produce thirty times as much heat as a milligramme of hydrogen.

At a future time, the author will show the fallacies involved in all these calculations. Meanwhile, enough has been said to set aside the *à priori* argument against electro-dynamic engines—namely, that as a pound of zinc can only produce a certain amount of heat, and a pound of carbon, which is much cheaper, can produce more heat, therefore electro-dynamic engines can never compete with steam engines. In fact, it is a question of prime cost of machinery, and skill in construction, and not of cost of working.

## ON THE CHEMICAL COMPOSITION OF THE BONES OF GENERAL PARALYTICS.\*

By J. CAMPBELL BROWN, D.Sc.,

Lecturer on Chemistry and Toxicology at the Liverpool Royal Infirmary School of Medicine.

IN consequence of the large share of public attention which has lately been attracted to the occurrence of fractures of the ribs among the patients in our lunatic asylums, several specimens of ribs of general paralytics have been sent to my laboratory.

The general appearance of all of them is so unlike that of the ribs of healthy adults, that I have been induced to submit average samples of them to analysis. In the accompanying table, the first four columns of figures show the composition of these samples.

I. Consisted of six ribs, which had all been fractured in a straight line downwards, and had completely united again by firm bony union; they showed slight callosities; some of them had again been fractured more recently, and had only imperfectly united; they contained an unusual amount of fat. Portions of the ribs were removed and were freed from fat before they were submitted to analysis, and the remaining portions were handed to the curator of the Museum of the Liverpool School of Medicine. The age of the subject from which they were taken was thirty-nine.

II. These ribs were not fractured, nor did they contain much fat; they were, however, thinner than usual. They were taken from the body of a patient who had suffered from mania with general paralysis.

III. Consisted of one rib only; it was slender and rough, and jagged on the edges, but had not been fractured. It was taken from the body of a woman aged forty.

IV. Shows the average proportions of organic and earthy matter in several samples not more completely analysed, which were remarkable only for being less perfectly developed than the ribs of healthy adults; some of these had been fractured and perfectly united, others were entire.

For comparison with these, I give the composition of the femur and tibia of a nine-months' foetus in column V., and of the bones from a case of osteo malacia in column VI.

VII. Is calculated from the analysis of a healthy adult tibia, by Valentin.

\* Read before the British Association, Liverpool Meeting, Section B.



VIII. Is calculated from the analysis of a healthy man, aged twenty-five, by Von Bibra.

Table of Analysis of Bones.

Constituents.	Ribs of General Paralytics.				V. Ninemoths, Fœtus.	VI. Osteo mal- acia.	VII. Tibia (Valentin).	VIII. Ribs (Von Bibra).
	I.	II.	III.	IV.				
Phosphoric acid	23'52	22'85	19'09		23'31	16'89	24'24	25'95
Lime .. ..	29'57	28'54	25'25		28'98	22'20	32'98	34'43
Magnesia and alkalies. }	0'41	0'43	0'37		0'36	1'05	1'37	1'67
Carbonic acid	1'55	1'29	2'09		1'10	1'71	3'37	2'90
Total inorganic constituents. }	55'05	53'11	47'80	49'46	53'75	41'85	61'96	64'95
Organic con- stituents }	44'84	47'02	53'05	50'54	47'15	58'16	38'02	33'97
	99'89	100'13	101'30	100'00	100'90	100'01	99'98	*98'92
Ratio of lime to 71 phos- phoric acid }	89	88	93		88	92	97	94

It will be observed that the ratio of organic constituents to earthy matter is much greater, and also that the ratio of lime to phosphoric acid is distinctly less in the ribs of paralytics than in those of healthy adults.

There are the same differences between the composition of healthy ribs and those of paralytics as between the composition of the adult large bones and those of the fœtus. And, generally, the composition in cases of paralysis approaches that observed in cases of osteo malacia.

Whether the defects in the ribs of paralytics are due to arrested development, or to degeneration of the fully developed bone, it will require further experiments upon carefully selected cases to prove; but from the evidence already obtained, I am led to conjecture that both causes will be found to operate, but principally the former.

I exceedingly regret that more analyses have not been made before this time; it will be readily understood that specimens of bones cannot be made to order; we must wait until they can be obtained at *post mortem*; and I propose to continue the enquiry when more specimens have been obtained.

The result of the analysis quoted is suggestive, rather than conclusive, as to the condition of the bones in patients the subject of general paralysis, and it is clearly unsafe to generalise from a few examples. These analyses, however, form a first instalment towards determining whether the statements that have been made as to the peculiar liability to fracture of the bones in certain forms of insanity holds good as a general rule.

## ON THE CALORIFIC POWER OF HARE'S BLOWPIPE.

By HENRY WURTZ.

OBSERVING in a lately received issue of the CHEMICAL NEWS, my first *partial* reply to Dr. W. M. Watts, I am encouraged to enclose a supplementary note in completion of said reply, lately printed by me in my own journal (*The American Gaslight Journal*). I perceive that Mr. Watts has also added a rejoinder to the aforesaid partial reply, which calls for a further continuation of the discussion on my part. I am gratified by the courteous tone of Dr. Watts's rejoinder, which I shall emulate.

Dr. W. M. Watts, in his strictures on the discussion of Professor Silliman and myself of the "Calorific Powers

or Effects of Gases," objects to our formula for the total heat of the oxyhydrogen flame, namely—

$$\frac{34462 - (9 \times 537^\circ)}{4'3245} = 6851^\circ;$$

remarking that "there is an error in assigning to liquid water the specific heat 0'4805, instead of 1. The formula should be—

$$\frac{34462 - 9 (637 - 48'05)}{4'3245} = 6743^\circ."$$

Dr. Watts's other points were probably sufficiently met in my reply, but this point was at that time expressly reserved, as looking to considerations which had already led to some little oral discussion between us, and with others.

Having had no opportunity, as yet, for that mature deliberation, in conjunction with Prof. S., that I desired to have, before going into print further on these questions of specific heat, and feeling that delay may cause misconstruction, I have given to them individually such consideration as I have had time for, and have decided to present a reply to Mr. Watts, in anticipation of our joint reply. In the preparation of the latter, arranged for an early day, any new lights that may appear in the interim, will of course be available.

Previous to the date of the first publication of our joint paper in the course of conversation with Prof. H. F. Walling, he made to me the suggestion that it was possible our formula ought to be so modified as to read—

$$\frac{34462 - 9 (537 + 51'95)}{4'3245} = 6743^\circ$$

leading, as will be seen, to the same figure as that of Dr. Watts. Prof. Walling, however, expressed himself as by no means *sure* of his view, as he had given no especial study to the subject, and offered it merely as an hypothesis. The apparent coincidence here gives more interest to the subject.

It is to be observed that Dr. Watts's formula supposes the temperature of the pound of hydrogen started with, in the combustion, to have been zero, and, further, that each of the nine pounds of water (as water) must have absorbed and retained 100° of sensible heat. Hence his figure 637°; which he diminishes, however, by 48'05°, for reasons which, as follows from the context, arise out of the difference between the specific heats of water and steam. The only conclusion I can draw from this is that Dr. Watts believes it requires an absorption of 51'95° of sensible heat from 1 pound of water at 100°, to convert it into 1 pound of steam at 100°, *plus* the 537° of latent heat generally admitted as the *actual result of experiment*; or, as may otherwise be stated, follows from Dr. Watts that the latent heat of steam at 100°, instead of 537°, is really 537° + 51'95 = 588'95°. I prefer as yet to stand by the experiment, until I receive from Dr. Watts some clearer explanation.

In the case of Prof. Walling, whose doubtfully submitted hypothesis also arose out of the consideration of the difference between the specific heats of water and steam, in the first place, it is clear at a glance, that the coincidence in the resulting figure is not accidental;

$$\text{for } 637 - 48'05 = 537 + 51'95;$$

and from this formula it is still more evident that, in addition to the 537° known by experiment to be all the heat that actually becomes latent in the conversion of one pound of water at 100° into one pound of steam at 100°, 51'95° more must be supposed to become latent, leaving but 48'05° of the sensible heat of the boiling water to remain sensible in the steam, and again increasing the latent heat of steam to the hypothetical number, 588'95°.

There must be a reason for every error (if this be one, as I cannot but conclude), as well as for every truth; and in seeking for the cause of this one, it seems to me to arise from a notion of specific heat, as absolute quantities, instead of mere *ratios*. The name is good, as it means

\* This specimen also contained fat which had not been removed before analysis.



merely that different *species* of matter are differently affected by equal additions of heat; and specific heats are merely the ratios of these differences. When a body changes its state, as from water to steam, the 537° required to produce this change of state produces also a *change of specific heat*. The sensible heat remains unaltered. The 537° must come from external sources. Steam is different in species from water, and possesses a different specific heat ratio. Time fails for a fuller exposition of this subject now.

With regard to our formula for the total heat of Hare's blowpipe, though Dr. Watts's correction, as I have endeavoured to show, does not appear to me sustainable, there has occurred to me a small correction, necessary to precision, which I shall call attention to, here and hereafter, for the reason that the principle on which it depends, is, in its application to combustible gases, becoming now of practical importance. This is merely a correction for the temperature of the hydrogen before burning, which, for simplicity, Silliman and Wurtz assumed to be zero. If this temperature is the ordinary one of 60° F. (= 15.6° C.), at first glance it might appear necessary merely to add 15.6° to the 34462 in the numerator of our fraction. This would involve an error, however, which, though trifling here, would be very important in cases where the combustible or supporter of combustion is highly heated beforehand. Such cases I will discuss at an early day hereafter. Here I shall merely explain that in the oxyhydrogen flame, we must first calculate the mean of the specific heats of the gases in combustion, thus—

$$\frac{3.409 + (8 \times 0.2175)}{9} = 0.5721;$$

and we shall then have, instead of 7969°, the figure calculated, in our joint paper, by Silliman and Wurtz, a temperature differing so little therefrom as to be scarce appreciable—

$$\frac{34462 + 15.6 \left( \frac{1}{0.5721} \right)}{43245} = 7975°.$$

The explanation of the details of this calculation I must for the present defer.

## LIME-LIGHTS IN THE CAISSON OF THE EAST RIVER BRIDGE.\*

ON page 190 of the last volume of the CHEMICAL NEWS, the fact was alluded to that arrangements had been made with the New York Oxygen Gas Co., to supply gas for a series of lime-lights by which the six compartments of this huge caisson might be lit.

We can now from personal inspection describe the arrangements by which some fourteen of these lights are kept in constant and successful operation. The plan of these adjustments is we understand, chiefly due to Mr. Martin, Assistant Engineer. To secure a steady supply of each gas under constant pressure, two large sheet-iron cylinders, about 21 inches in diameter and 6 feet high, are placed upon the top of the caisson, and are connected by iron piping with a water reservoir on the roof of an adjacent building, by which means a hydrostatic column or pressure of some 16 pounds per square inch is made available. These cylinders being filled with water, the gas is let into them from the portable cylinders supplied by the Oxygen Co., in which it is compressed up to a pressure of 225 pounds to the square inch. This displaces the water, forcing it back into the elevated tank and leaving only the tension due to its hydrostatic column of 32 feet.

Glass gauges exactly like those used on steam boilers show the level of the water in the stationary cylinders, and thus enable the attendant to regulate the supply of

gas in these, so as neither to overcharge them (when the excess would escape through the water-pipes and tank) nor allow them to become empty.

From the upper part of the gas reservoirs or stationary cylinders just described, service pipes are carried down into the caisson, and there distribute to the outer ends and middle points of each chamber where the usual jets and lime holders are permanently attached.

The light afforded by this means is excellent, and if it is possible (as we imagine it must be) to whiten the roof and upper part of the caisson walls, its efficiency would be very largely increased. In looking from one chamber of the caisson into another, where one of the lights was near the doorway but out of view, we were strongly impressed with the idea that daylight was entering through some unexpected opening. The foggy state of the air causes a considerable loss of light, so that at a distance from the burner this is less effective than one might expect. With the number of lights now in use, however, the supply is sufficient, and candles are only required in a few locations sheltered from the direct rays. We feel sure that a whitening of the roof and walls would be of very great service.

It is proposed to let the gas reservoirs descend as the caisson goes down, building around them a coffer-dam, by which means the hydrostatic head will be increased exactly as the air pressure in the chambers is raised, so that a constant difference will be maintained.

The greatest depth to be reached being 40 feet, the maximum pressure required, according to the present standard, would be about 36 pounds, and the pressure in the small charged cylinders being 225 pounds, no difficulty will be found in introducing the gas from them. The pressure now used is, however, largely in excess of what is required, as one or two pounds above that in the caisson would be quite sufficient to secure the steady burning of the lights. In fact, we are sure, from previous experience, that the pressure between the stop-cocks of the jets and the flames is now not more than a small fraction of a pound per square inch in excess of the surrounding compressed air. Were there any object in reducing it, we are quite confident that 25 pounds above the atmosphere would be an abundant pressure at the maximum depth of 40 feet.

The amount of gas now consumed is about 1200 cubic feet of each kind per day.

## THE RISE AND FALL OF THE DEFUNCT ELEMENTS.\*

By Dr. H. CARRINGTON BOLTON.

A COMPLETE catalogue of so-called "Defunct Elements," is nowhere found, but notices of their *rise* and *fall* are scattered throughout periodical literature; from these the following list has been compiled, which, if incomplete, is still comparatively full. Within the limits of this abstract, little more than the date, name of discoverer, and references can be given. Taking them up in chronological order, the first is

*Terra Nobilis*, discovered in 1777, by Tobern Bergmann, who extracted it from diamonds.

*Hydrosiderum*, discovered by Meyer, in 1780, and obtained by dissolving crude iron in acids, the residue being the new element. It is called in German *Wassereisen*. Klaproth showed that it consisted of iron combined with phosphorus. (*Schrift. Ges. Nat. Freund, Berlin*, ii., 334; and iii., 380.)

*Saturnum*, discovered in 1784, by Monnet. (*Journal de Physique*, xxviii.)

*Diamanthspatherde*, discovered in 1788, by Klaproth, in corundum. (*Beschäft. Ges. Nat. Freunde, Berlin*, viii., St. 4.)

\* Communicated by Professor Morton. From advance-sheets of the *Journal of the Franklin Institute*.

\* From the *Proceedings of the Lyceum of Natural History, New York*.



*Australia*, discovered in 1790, by Wedgewood, in sand from Australia, and examined by Hatchett, who pronounced it a mixture of alumina, iron oxide, silica, and graphite.

*Nameless earth*. Fernandez, 1799. *Scherer's Allg. J.*

*Agusterde* was extracted from the mineral known as *sächsische-beryll*, by Trommsdorff, in the year 1800. Vauquelin showed it to consist of phosphate of lime, the mineral being known as apatite. (*Scherer's Allg. J.*, iv., 312; also *Gehlen's Allg. J.*, i., 445.)

*Silene*, Proust, 1803. (*Journal de Physique*.)

*Pneum alkali*, discovered by Hahnemann in 1801. It was sold at the price of one gold Frederic the ounce, but eventually proved to be borax.

*Niccolanum*, was found in cobalt ores by Richter, in 1805, but was shown to consist of a mixture of nickel, cobalt, arsenic, and iron. (*Gilb. Ann.*, xix. 377.)

*Andronia*, an earth which existed only in the imagination of J. J. Winterl, of Pesth. He prepared it by igniting charcoal with saltpetre and exhausting with water, the residue consisting of *andronia*. His statement excited much controversy; a committee of the French Academy of Sciences appointed to examine it, proved that it was but a mixture of lime, alumina, iron oxide, and silica, which materials, it was suggested, came from the earthen crucibles in which Winterl conducted the experiments. (*Gehlen's J. und Gilberts Annalen*.)

*Thelike*, discovered by Winterl.

*Nitricum*, is the imaginary body, which, according to Berzelius, united to oxygen formed nitrogen.

*Araeon*, is in accordance with Meissner's views, *ponderable caloric*; thus hydrochloric acid is composed of two equivalents of oxygen and one of water, combined with araeon and the imaginary radical murium. (*Handwörterbuch*.)

*Funonium*, discovered by Thomson, in 1811, but its identity with cerium was soon proved by Wollaston. (*Phil. Mag.*, xxxvi., 278; also *Gilb. Ann.*, xlv., 113.)

*Thorium*; the first element known by this name, proved to be phosphate of yttria. (*Schweigg.*, xxi., 15; *Pogg. Ann.*, iv., 145.)

*Vestium*, discovered in 1818, by von Vest. Faraday showed that it consisted of a mixture of iron, nickel, sulphur, and arsenic. (*Gilb. Ann.*, lix. and lxii.)

*Wodanium*, extracted from the so-called *Wodankies* by Lampadius, 1818, but shown by Stromeyer to consist of nickel, arsenic, &c. The mineral is now known as Gersdorffite. (*Gilb. Ann.*, lx. and lxiv.)

*Crodonium*, discovered by Trommsdorff in 1820, was found in an incrustation, on a carboy of sulphuric acid imported from England. Its name is derived from *Crodo*, an idol held in veneration by the ancient people of Thuringia. Trommsdorff afterwards showed that it was but lime and magnesia, rendered impure by copper and iron. (*Gilb. Ann.*, lxv. and lxvi.)

*Apyre*, Brugnatelli, 1821. (*Gilb. Ann.*, lxvii.)

*Pluranium*, *Polinium*, and *Ruthenium*, all three discovered by Osann (1828), in platinum ores from the Ural Mountains. (*Pogg. Ann.*, xiii. and xiv.)

*Donium*, discovered in 1836, by Richardson, in a mineral from Aberdeen, but its identity with glucinum was afterwards established by Heddle. (*Ann. Chem. Pharm.*, xix. and xxiii.)

*Treenium*, discovered by Boase, in 1836, and partly supposed identical with donium. (*Thomson's Records Gen. Sci.*, iv., 20.)

*Terbium*, found accompanying erbium in gadolinite, by Mosander (1843), but pronounced by Berlin (1860), to have no existence. (*Ann. Chem. Pharm.*, lxviii., cxxxi., cxxxvii., &c.)

*Pelopium*, discovered by Rose, in 1846, and supposed to accompany niobium (columbium). Rose has shown that pelopic acid is convertible into niobic acid, and this into hyponiobic acid. (*Pogg. Ann.*, lxix. and xc.)

*Ilmenium*, discovered in 1846, by Hermann. (*Journ. Pr. Chem.*, xxxviii. and xl.; also *Pogg. Ann.*, lxxiii.)

*Aridium*, discovered in 1850, by Ullgren. (*Journ. Pr. Ch.*, lii.; *Ann. Ch. Pharm.*, lxxvi. and lxxxviii.)

*Donarium*, discovered in 1851, by Bergmann. (*Ann. Ch. Pharm.*, lxxx. and lxxxiv.)

*Thalium*, discovered in 1852, by Owen. (*Am. J. Sci.*, (2) xiii., xvi., and xvii.)

*Nameless metal* of platinum group, discovered by Genth, in 1853. (*Am. J. Sci.*, (2) xv.)

*Dianum*, extracted from tantalite from Finland, by von Kobell, (1860). H. Rose questioned its identity, also Sainte-Claire Deville and Hermann. Von Kobell distinguished it from niobic and tantalic acids, by the formation of a deep blue solution, when treated with tin and hydrochloric acid. (*Ann. Ch. Pharm.*, cxiv., and cxxxvi.)

*Wasium*, discovered by Bahr, in 1862. (*Pogg. Ann.*, cxix., 572; *Journ. Pr. Ch.*, xci., 316.)

*Nameless earth* of the calcium group, Dupré, 1861.

*Nameless metal* of platinum group, Chandler, 1862. (*Am. J. Sci.*, (2) xxxiii.)

*Fargonium*; under this head are collected the various oxides supposed to accompany zirconia; it appears that six chemists have independently suspected the compound nature of zirconia, as follows:—

- |                            |          |              |
|----------------------------|----------|--------------|
| (1.) <i>Norium</i>         | in 1845, | by Svanberg. |
| (2.) <i>Nameless earth</i> | in 1854, | „ Sjögren.   |
| (3.) <i>Nameless earth</i> | in 1864, | „ Nylander.  |
| (4.) <i>Nigrium</i>        | in 1866, | „ Church.    |
| (5.) <i>Fargonium</i>      | in 1869, | „ Sorby.     |
| (6.) <i>Nameless earth</i> | in 1869, | „ Loew.      |

The references are as follows:—

- (1.) *Berz. Jahresb.*, xxv.; *Journ. Pr. Ch.*, lvii. and xcvi. (2.) *Journ. Pr. Ch.*, lv. and lvii. (3.) *Acta Univers. Lundensis*, 1864. (4.) *CHEM. NEWS*, 1869. (5.) *Idem*. (6.) *Annals. N. Y. Lyc. Nat. Hist.*, ix., 211.

Summing up all the reactions by which these unknown oxides are distinguished from zirconia we have the following table.

- |   |                          |
|---|--------------------------|
| (1.) Great variation in atomic weight of oxide.   | Svanberg.                |
| (2.) Solubility of oxide in oxalic acid.          | Svanberg, Sjögren, Loew. |
| (3.) Solubility of chloride in hydrochloric acid. | Svanberg and Forbes.     |
| (4.) Precipitation by ferrocyanide of potassium.  | Sjögren.                 |
| (5.) Insolubility of tartrate in tartaric acid.   | Forbes.                  |
| (6.) Solubility of double potassium sulphates.    | Nylander.                |
| (7.) Variation in nature of sulphates.            | Loew.                    |
| (8.) High. sp. gr. of oxide (5.5 instead of 4.3). | Sjögren.                 |
| (9.) Black absorption bands of spectrum.          | Church, Sorby.           |

(2.) Some misapprehension exists on the second point, owing to the fact that most text-books state that zirconia is *insoluble* in oxalic acid, whereas, Berlin, in 1853, showed, on the contrary, that zirconia is readily and completely *soluble* in oxalic acid.

In Finkener's revised edition of H. Rose's work, the error contained in earlier editions is corrected.

(8.) Berlin found the sp. gr. of zirconia from catapleite = 4.9, precisely the mean of the other two.

(9.) The manner in which Sorby has explained the last point is familiar to all.

**Preparation of Barium Chlorate.**—Brandau has proposed the following simple method for the preparation of barium chlorate:—Commercial crystallised aluminium sulphate, sulphuric acid, and potassium chlorate, in the ratio of one molecule of each of the two former to two of the latter, are mixed with water to the consistence of a thin paste, warmed for half an hour on the water-bath, allowed to cool completely, and treated with alcohol in excess. Upon filtering, and neutralising with barium hydrate, barium sulphate and some aluminium hydrate are precipitated, and barium chlorate remains in solution. The alcohol is distilled off, and the filtrate on evaporation yields crystals of the pure barium chlorate. The only precaution necessary is to have the aluminium sulphate and the sulphuric acid in slight excess.—*Ann. Ch. Pharm.*, cli., 361. *Am. Journ. Sci.*, No. 148.



ON THE  
PRECIPITATION AND DETERMINATION  
OF THE  
METALS OF THE MAGNESIUM GROUP IN  
THE FORM OF OXALATES.

By W. GOULD LEISON.

PROFESSOR GIBBS has recently\* called attention to the fact that a number of metallic oxides may be completely precipitated from their neutral solutions by means of oxalic acid, provided that a large excess of alcohol be also added. As it is not easy to obtain precise quantitative results by igniting the oxalates so precipitated, in consequence of the extreme subdivision of the resulting oxides, Professor Gibbs suggested the employment of potassic hypermanganate for the combustion of the oxalic acid—a method which, as is well known, gives excellent results in the case of calcic oxalate precipitated in the ordinary manner. The following investigation was undertaken for the purpose of testing this method of analysis:—

**Cadmium.**—Cadmic sulphate was dissolved in the least possible quantity of water, oxalic acid added in excess, and then a large quantity of strong alcohol. The resulting oxalate was beautifully crystalline, and the precipitation was so complete that  $\text{SH}_2$  gave, in the filtrate, a scarcely perceptible yellowish tinge. The oxalate was washed with alcohol by Bunsen's method, and dried at  $110^\circ \text{C}$ ., until every trace of alcohol was expelled. The filter was then pierced with a glass rod, and the cadmic oxalate washed into a flask with hot diluted sulphuric acid. A few cubic centimetres of strong sulphuric acid were then added, and the hot solution titrated with potassic hypermanganate. In this manner, four experiments gave 44.19 per cent, 44.65 per cent, 44.88 per cent, and 44.27 per cent of cadmium, as computed from the oxalic acid. These results are all much too high, and show that the acid had acted sensibly upon the filter. Two other experiments were then made. In the first, a hot solution of ammoniac sulphate was used as a solvent for the oxalate; in the second, hot dilute chlorhydric acid was employed. Of the hypermanganic solution employed, 100 c.c. contained 0.1103 gr. of available oxygen.

- I. 0.4330 gr. cadmic sulphate required 24.5 c.c. hypermanganate = 43.68 per cent Cd.
- II. 0.3724 gr. cadmic sulphate required 21.1 c.c. hypermanganate = 43.74 per cent Cd.

The received formula,  $3\text{CdSO}_4 + 8\text{H}_2\text{O}$ , requires 43.75 per cent. In these two analyses the filters were not broken.

**Barium.**—Baric chloride gave extremely variable results in my first experiment, notwithstanding the fact that the barium is completely precipitated by oxalic acid and alcohol. The resulting oxalate, after washing and drying, was not completely decomposed by sulphuric acid, which appeared to form a crust of baric sulphate upon the crystals of the oxalate. This difficulty was finally overcome by dissolving the baric oxalate in chlorhydric acid and diluting the solution largely. In this manner—

0.6505 gr. baric chloride required 80 c.c. hypermanganate = 56.21 per cent Ba (100 c.c. hypermanganate solution contained 0.053 gr. available oxygen). The formula  $\text{BaCl}_2 + 2\text{H}_2\text{O}$  requires 56.15 per cent Ba.

**Strontium.**—To avoid the use of paper filters, so as to be able to employ sulphuric acid as a solvent, I resorted to sand filters. A light funnel was ground truly conical near the throat; a little pear of glass with a long stem was then dropped into the funnel, stem upward. In this manner, a valve was formed impassable to the sand laid upon the ball of the glass, but allowing liquids to pass freely. By means of the stem, the valve could be lifted

from its seat, and the sand and precipitate washed together into a flask, after careful drying. With this arrangement:—

0.4292 gr. strontic nitrate required 47.8 c.c. hypermanganate = 48.90 per cent  $\text{SrO}$ .  
0.3657 gr. strontic nitrate required 40.8 c.c. hypermanganate = 48.90 per cent  $\text{SrO}$ . (100 c.c. hypermanganate solution contained 0.1099 gr. available oxygen.)

The formula  $\text{Sr}(\text{NO}_3)_2$  requires 48.93 per cent  $\text{SrO}$ . Sulphuric acid only was used to decompose the oxalate.

**Calcium.**—Iceland spar was dissolved in chlorhydric acid, and the solution treated with oxalic acid and alcohol. The filtrate contained calcium. When, however, the solution was evaporated to dryness before adding alcohol, and the oxalate was washed on a sand filter, no traces of calcium could be detected in the filtrate. In this manner—

0.5090 gr.  $\text{CaCO}_3$  required 70.6 c.c. hypermanganate = 56.10 per cent  $\text{CaO}$ . (100 c.c. hypermanganate corresponded to 0.11559 gr. oxygen.)  
0.5590 gr.  $\text{CaCO}_3$  required 77.5 c.c. hypermanganate = 56.08 per cent  $\text{CaO}$ . (100 c.c. hypermanganate corresponded to 0.11495 gr. oxygen.)

The formula requires 56.00 per cent  $\text{CaO}$ . Sulphuric acid only was employed.

**Magnesium.**—When magnesian sulphate is treated with oxalic acid, the mixture evaporated (but not to dryness), and alcohol added, the filtrate is perfectly free from magnesium. In this manner—

0.3243 gr.  $\text{MgSO}_4 + 7\text{H}_2\text{O}$  required 39.6 c.c. hypermanganate = 16.18 per cent  $\text{MgO}$ .  
0.3949 gr.  $\text{MgSO}_4 + 7\text{H}_2\text{O}$  required 48.4 c.c. hypermanganate = 16.25 per cent  $\text{MgO}$ .

In these analyses, the oxalate was collected on a paper filter, and washed into the flask with water after piercing the filter, which was washed with cold dilute sulphuric acid. The formula requires 16.26 per cent.

**Zinc.**—Zinc is completely thrown down from its sulphate by the unmodified process. The oxalate forms an extremely fine powder. A sand filter and warm dilute sulphuric acid were employed.

0.9301 gr. sulphate required 47.1 c.c. hypermanganate = 28.14 per cent  $\text{ZnO}$ .  
1.0788 grs. sulphate required 54.6 c.c. hypermanganate = 28.15 per cent  $\text{ZnO}$ .

The formula requires 28.22 per cent  $\text{ZnO}$ .

**Cobalt.**—Perfectly pure anhydrous cobaltous chloride was prepared by igniting chloride of purpureo-cobalt. The chloride was then precipitated by oxalic acid and alcohol, collected on a sand filter, and digested with dilute sulphuric acid. The solution was intensely red. A solution of nickeliferous sulphate was then added, until the red colour disappeared and a faint smoky hue took its place.\* In this manner—

0.4292 gr.  $\text{CoCl}_2$  required 47.8 c.c. hypermanganate = 45.30 per cent  $\text{Co}$ .  
0.3657 gr.  $\text{CoCl}_2$  required 40.8 c.c. hypermanganate = 45.37 per cent  $\text{Co}$ .

The formula requires 45.38 per cent ( $\text{Co} = 59$ ).

**Nickel.**—In the case of nickeliferous sulphate, it was found necessary, after adding the oxalic acid, to concentrate the mixture on a water-bath before adding alcohol, and then further digest for about half an hour, replacing the alcohol as fast as it evaporated. The oxalate was collected on a paper filter, and, after washing, dissolved in ammonia on the filter. The filtrate was then acidified

\* *Amer. Journ. Sci.*, vol. xlv., p. 213.

\* Compare, as regards this method, W. Gibbs, *Amer. Journ. Sci.*, vol. xiv., p. 204.



with sulphuric acid, and the colour finally discharged by a solution of cobaltous sulphate. In this manner—

0.9585 gr. nickeliferous sulphate required 42.2 c.c. hypermanganate = 28.57 per cent NiO.

1.0287 gr. nickeliferous sulphate required 45.3 c.c. hypermanganate = 28.58 per cent NiO.

The formula  $\text{NiSO}_4 + 6\text{H}_2\text{O}$  requires 28.24 per cent NiO (Ni=58), but it is very difficult to obtain the sulphate in a perfectly definite state of hydration.

*Manganese.*—Although manganese is completely precipitated from its soluble salts by oxalic acid in the presence of alcohol, my results with the method have not been satisfactory, owing, as I suppose, to my not having a definite salt for analysis. The following analyses show, at any rate, that closely corresponding results can be obtained when the same substance is taken:—

0.3760 gr. manganous oxalate required 30.50 c.c. hypermanganate = 38.38 per cent MnO.

0.4013 gr. manganous oxalate required 32.55 c.c. hypermanganate = 38.38 per cent MnO.

The salt  $2\text{C}_2\text{MnO}_4 + 5\text{H}_2\text{O}$ , when dried in air, requires 37.77 per cent MnO, while the salt analysed was dried at 100° C. In like manner, two analyses of a sulphate, which had probably absorbed a little water, gave 45.28 per cent and 45.29 per cent of MnO. The crystallised sulphate,  $\text{MnSO}_4 + 7\text{H}_2\text{O}$ , requires 46.67 per cent.

*Iron.*—Good results could not be obtained by the application of this method to the determination of iron, but I am not at present able to assign the reason of the failure in this case.

To complete my work, it remains for me to point out the applicability of the process to the determination of the whole quantity of oxygen contained in a number of bases present together in solution—a problem which is sometimes of interest.

Sulphates of manganese, magnesium, nickel, cobalt, cadmium, and zinc, in undetermined quantities, were dissolved together in water, and the solution well shaken. Four portions, of 100 c.c. each, were then taken, and the acid determined in each by baric chloride. In two other equal portions, the bases were precipitated as oxalates and titrated as above. The oxygen in the acid was then calculated from the amount of baric sulphate. In this manner it was found that the oxygen in the acid was, to that in the mixed bases, as 3 to 1 very nearly, the precise ratio being, in the one case, as 0.054 is to 0.018, and in the other as 0.055 is to 0.018. Another experiment was made with a crystallised dolomite containing 0.45 per cent of insoluble residue. The lime, magnesia, and iron were precipitated together, and titrated as oxalates; the carbonic acid was determined by ignition. In this manner, the oxygen of the acid was found to be, to the oxygen in the bases, as 34.48 is to 17.28. The bases, after ignition, amounted to 52.41 per cent.

In another experiment with a dolomite from a different locality, containing 0.13 per cent of insoluble residue, the oxygen ratio was found to be as 34.56 is to 17.28, the bases amounting to 52.33 per cent. If we calculate the relative quantities of calcic and magnesian carbonates from the sum of the two oxides in the last analysis, and the oxygen found by titrating the oxalate, we find—

$\text{MgCO}_3$	..	..	..	..	42.77
$\text{CaCO}_3$	..	..	..	..	57.07
Insoluble residue	..	..	..	..	0.13

99.97

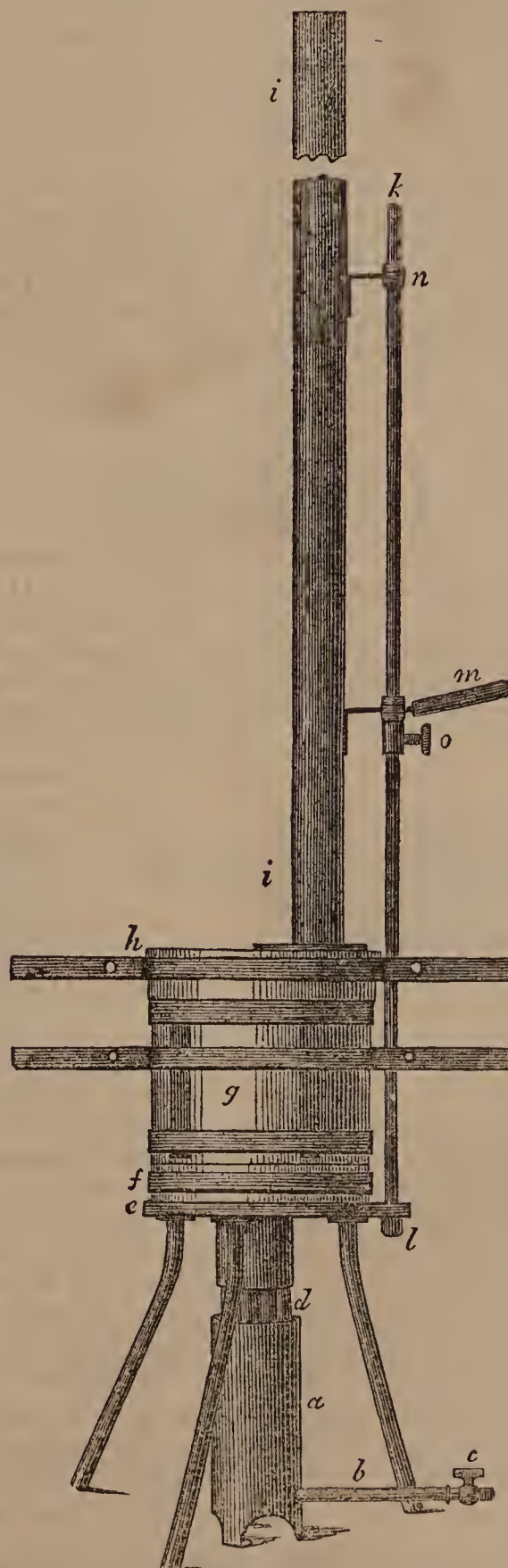
The small quantity of ferrous oxide present being neglected. This analysis will serve to show the applicability of the method in indirect analyses. My results appear to me to furnish a generalisation of the use of potassic hypermanganate, which will be received with favour by those who employ this reagent frequently in volumetric analyses.

# DESCRIPTION OF A GAS FURNACE FOR CHEMICAL OPERATIONS AT A WHITE HEAT, WITHOUT THE AID OF A BLOWING MACHINE.

By CHARLES GRIFFIN.

FUSIONS at a white heat can be readily effected by a gas furnace supplied with air by a blowing machine. But a furnace of that description has several defects:—The blowing machine is expensive; it is cumbersome in a laboratory; it demands constant labour during a fusion;

FIG. 1.



and it produces so much noise as to interrupt every kind of quiet work.

The furnace to be described in the following notes is free from these defects. It is small and portable, easily put together and taken asunder. It demands no blowing machine, and only a small chimney. It acts without smoke, or dust, or noise. Its heating power is sufficient to raise a 4½-inch clay crucible, filled with metal, to a



white heat. Cast-iron can be fused in it and cast into ingots of the following weights :—

A. Commencing with the furnace cold—

An ingot of 2 lbs. in 70 minutes.

An ingot of 3 lbs. in 90 minutes.

An ingot of 4 lbs. in  $2\frac{1}{2}$  hours.

B. Commencing with the furnace hot—

An ingot of 2 lbs. in 40 minutes.

An ingot of  $2\frac{1}{2}$  lbs. in 50 minutes.

An ingot of 5 lbs. in  $2\frac{1}{2}$  hours.

Silver, gold, and copper can be fused in larger quantities and in less time.

The furnace is represented by Fig. 1. Its height, including the stool, is about 2 feet. The external diameter is 8 inches. It consists of the following parts :—

*a* is a brass cylinder, open at the bottom, and into the top of which sixteen Bunsen's burners are fixed; gas is supplied by the pipe, *b*, regulated by the stop-cock, *c*. A jacket surrounds the upper part of the Bunsen's burners, but is cut away at the bottom, *d*, in order to permit air to pass up between the burners.

The consumption of gas by this compound burner when at work in the furnace is 33 cubic feet per hour.

*e* is an iron stool, which supports the furnace and also the iron rod, *k*, to which the chimney is attached.

*f* is a fire-clay sole plate, shown in section by Fig. 2. The system of burners is closely fixed in the perforation of this plate.

FIG. 2.



*g* is a cylinder of fire-clay, shown in section by Fig. 3. It measures 6 inches in height, 8 inches in external diameter, and 5 inches in bore. The crucible to be heated is supported on a perforated plumbago cylinder, represented in section by Fig. 3, and in perspective by Fig. 4. In

FIG. 3.

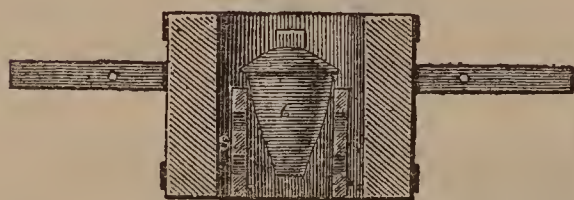
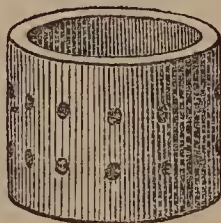


FIG. 4.



order to secure the greatest degree of fusing power, the bottom of the crucible, *c*, Fig. 3, should be fixed at 1-inch or  $1\frac{1}{4}$ -inch distance from the face of the bundle of gas-burners, *a*, Fig. 1. For this purpose, the two plumbago cylinders supplied with the furnace differ  $\frac{1}{2}$  inch in height.

The crucible must be conical, not barrel-shaped, in order that the flame, after striking the crucible, may have space to escape through the holes in the plumbago cylinder.

The distance between the outside of the plumbago cylinder and the inside of the furnace cylinder, that is to say, the space marked *s, s*, in Fig. 3, must not exceed  $\frac{1}{2}$  an inch all round. Increase of space here lessens the heating power of the furnace.

*h*, Fig. 1, is the dome or roof of the furnace. It is represented in section by Fig. 5. This figure shows that the

FIG. 5.



flame, in rising from the body of the furnace, is bent twice at a right angle before it passes into the chimney.

*i, i*, Fig. 1, is an iron chimney, which measures 4 feet in length, and 2 inches in diameter; *k* is a vertical iron rod, screwed into the stool, *e*, of the furnace at *l*. This chimney is movable by the handle, *m*. At *n* there is a guide, and at *o* a stop. By this arrangement the chimney

can be set on the furnace, or moved aside, with facility. This movement is sufficient when the furnace is used for simple fusions, or when no deleterious gases are driven off; but when arsenic, sulphur, &c., are expelled during an operation, and the entire apparatus cannot be placed under a hood or fixed chimney, then the upper end of the chimney, *i, i*, should be passed into the vertical branch of a knee-piece, the horizontal branch of which is connected with a fixed flue, and the chimney, *i, i*, should be raised within the knee-piece by moving upwards the stop, *o*, on the rod, *k*. A rise of about 6 inches is necessary to make room for the removal of the dome, *h*, and the cylinder, *g*, on dismantling the furnace to remove a crucible. It is necessary to see that the draught of the fixed chimney is not too powerful.

The method of mounting crucibles exhibited by Fig. 3 serves for  $4\frac{1}{2}$  inch and for 4 inch crucibles, but not for smaller sizes. A 3 inch crucible slips through the plumbago cylinder and spoils the draught, and if a smaller cylinder is used, the spaces, *s s*, Fig. 3, become so wide that the effective heat of the furnace is greatly diminished. Hence it is necessary, when small crucibles are to be used, to support them on a grate made of fire-clay, the best form of which is represented by Fig. 6. Its diameter is

FIG. 6.

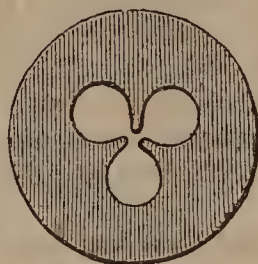
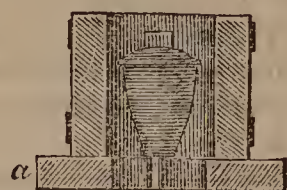


FIG. 7.



6 inches. This grate is placed upon the sole plate of the furnace. The crucible is set upon it, and is surrounded by a smaller fire-clay furnace cylinder, namely, by one that measures 5 inches in height, 6 inches in external diameter, and 4 inches in bore. The dome, Fig. 5, or *h*, Fig. 1, is used with the small cylinder, Fig. 7, as well as with the large cylinder, Fig. 3.

Platinum and porcelain crucibles can be heated in the small furnace, Fig. 7, enclosed in fire-clay crucible cases.

The fire-clay grate, Fig. 6, can be used with the large cylinder, Fig. 3; and, in crucibles supported by it, as much as 3 lbs. of cast-iron can be melted; but the operation requires an extra half-hour of ignition beyond that required when the crucible is supported by the plumbago cylinder, Fig. 4.

When the furnace is mounted for use with the large cylinder, Fig. 3, three bronze pennies are put on the sole plate, *f*, Fig. 1, to support the cylinder, *g*; when the grate is used, the three pennies are put under the extreme edge of the grate. These pennies leave a space for the admission of air.

Operations that succeed at moderate temperatures, such as the fusion of zinc in an iron pot or ladle, are performed without using the dome and chimney. The vessel to be heated is to be placed on the inner cylinder of Fig. 3.

The furnace body, Fig. 3, and the dome, Fig. 5, are provided with iron handles. These never become very hot, not even when the furnace contains 3 lbs. of melted iron. The operator's hands are sufficiently protected when lifting these pieces by a couple of folds of thick cloth, or brown paper. The small cylinder, Fig. 7, is handled by the same bow tongs that serve to lift the hot crucibles.

Access to the crucible in the furnace is gained at any moment by turning aside the chimney, and lifting the dome, *h*, Fig. 1. When the crucible is to be removed, the dome is first taken from the furnace, and placed on a circular plate of fire-clay; the outer cylinder is next lifted off, and placed on a similar plate of fire-clay. The crucible can then be removed by the bow tongs. If the furnace is to be immediately used for a second operation, the



cylinder should be covered with a third clay plate, to retard the loss of heat while the crucible is being replaced by another.

**GAS MUFFLE FURNACE.**—When the furnace cylinder, *g*, Fig. 1, is replaced by an oval furnace body that contains a muffle, as represented by *M* in Fig. 8, all other

FIG. 8.

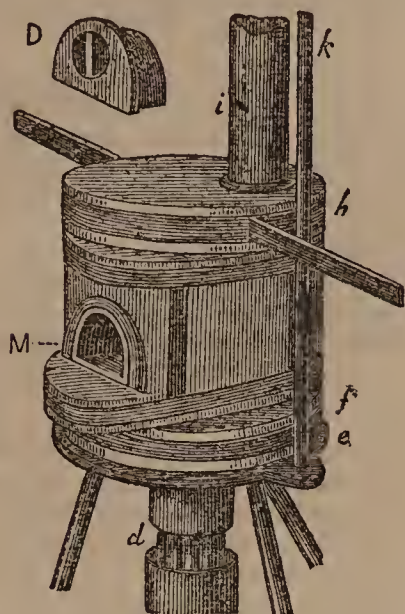


FIG. 9.



parts of the furnace remaining as represented by Fig. 1, the usual muffle operations can be performed, such as cupellation, the roasting of ores, the combustion of organic bodies for their ashes, the burning of filters, &c. The muffle belonging to this furnace measures 7 inches in length,  $3\frac{1}{2}$  inches in width, and  $2\frac{1}{2}$  inches in height. It requires a bright red heat, sufficient to melt silver, gold, and copper. This heat can be kept steady and uniform for hours; and being free from dust or soot, is particularly suitable for such operations as annealing.

Nothing new is offered in the burner of this apparatus, for it is merely a bundle of Bunsen's jets; nor in the fire-clay fittings, which are copied from Griffin's Blast Gas Furnace; but a few words may be said on one or two other points.

The first relates to the supply of gas and air. The greatest heat is produced when coal-gas is burnt in the presence of as much air as entirely decomposes and oxidises it; that is to say, when one volume of gas is mixed with ten or twelve volumes of air; but when gas is mixed directly with so large a quantity of air, it becomes explosive, and cannot be used as fuel. It is consequently necessary, in the management of a gas furnace, to supply the air, certainly as rapidly as the combustion demands, yet so gradually as to avoid explosions. In arranging the furnace now under discussion, the gas is supplied in excess, and the air in three successive doses:—the first quantity at the bottom of the cylinder, *a*, Fig. 1; the second at the openings, *d*, Fig. 1; and the third, where the three bronze pennies are placed on the sole plate, either under the cylinder, Fig. 3, or the grate, Fig. 6. By this arrangement, the gas is fully supplied with air, while the chance of explosion is almost entirely obviated. When, however, the furnace is in operation at a white heat, if the gas supply-pipe is *pinched*, an explosion occurs, because, under the action of the hot furnace and the chimney, the air is immediately brought into excess. In such a case, as soon as an explosion is heard, the gas should be turned off, the chimney be moved aside, and the opening in the dome of the furnace be closed by a crucible cover. The draught of air is thus stopped. If now the gas is turned on fully, it takes fire properly in the body of the furnace, and, the chimney being replaced, the operation proceeds as usual.

The second point to be noticed is the form of the flue in the furnace roof, or dome, Fig. 5. By this contrivance, the rising current of flame and gas is bent twice at a right angle, and an obstruction is produced between the body of the furnace and the chimney, without which the gases would escape too readily into the chimney, and

burn there instead of in the furnace. If the roof, Fig. 5, is replaced by a flat perforated plate similar to Fig. 9—the same furnace and chimney being used—the diminution of heating power is very considerable.

The progress of an ignition is judged of chiefly by the colour of the fire, as seen through the crevices of the furnace between the pieces *f* and *g*, and *g* and *h*, in Fig. 1. The eye soon learns to distinguish the colour which indicates an *iron-melting* heat.

The proper admixture of gas and air is judged of from the colour and quantity of flame which passes up the chimney. To enable the operator to see this flame, three small holes are bored in the chimney. The flame is never seen at the upper hole, unless the supply of gas is too large; but it is always visible at both the lower holes. As there are no valves to regulate the supply of air, due attention must be paid to the supply of gas.

## MISCELLANEOUS.

**Chair of Chemistry at St. Bartholomew's.**—We learn that Mr. J. Alfred Wanklyn, Dr. Russell, F.R.S., Dr. Dupré, and Mr. Maxwell Simpson are spoken of as candidates for the above vacant chair.

**The Chemical Society.**—The first meeting of the session will be held on Thursday, November 3rd, at 8 o'clock, when Mr. A. H. Elliott will read a paper on "The Analysis of Cast-Iron."

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

*Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

**NORW.** All degrees of temperature are Centigrade, unless otherwise expressed.

*Berichte der Deutschen Chemischen Gesellschaft zu Berlin*, No. 14, 1870.

From the report of the latest meetings of this Society, we learn that Mr. Roberts, chemist to the Royal Mint, London, has been elected a Member of the Society. This number contains the following original papers and memoirs:—

**Action of Sulphuric Acid on Organic Chlorides which contain Nitrogen.**—A. Oppenheim.—The author states that, after having previously studied the action of sulphuric acid on organic chlorides, he proceeded to the investigation of the action of that acid upon chlorides which also contain oxygen. He found that, generally speaking, there is no difference in this action; because, according to the degree of saturation of the substance, it either combines directly with  $H_2SO_4$ , or  $Cl$  is driven off in the form of  $HCl$ , and, in its stead,  $H_2SO_4$  combines with the substance. The molecule,  $HSO_4$ , is readily replaced by hydroxyl. As an instance, the author quotes the monochlorhydrine of glycol,  $C_2H_4.OH.Cl$ , which behaves exactly as chloroethyl,  $C_2H_5Cl$ , there being formed, while  $HCl$  is given off, the conjugate acid,  $C_2H_4.OH.SO_4H$ . The lengthy paper contains, further, the account of a series of experiments made with benzoyl-chloride, which, when acted upon by sulphuric acid, yields a monobasic sulphobenzoic acid,  $C_6H_5.CO.SO_4H$ . Acetyl-chloride, and the chlorides of phthalic acid, are acted upon in the same manner by sulphuric acid.

**Sulphobenzoic Acid.**—E. Ador and A. Oppenheim.—This paper contains a detailed account of a comparative investigation instituted with the sulphobenzoic acid mentioned in the foregoing paper, and with the same acid as obtained when prepared by a different method. The result is, that the identity of these bodies is fully established.

**Nitro-Naphtoë Acid.**—O. Küchenmeister.—After referring to the researches made on this subject by MM. Schüffer, Wichelhaus, Merz, Mühlhauser, and others on this subject, the author treats, at great length, on  $\alpha$  and  $\beta$  naphtoë acid, both of which are readily nitrated. The  $\alpha$  nitro-naphtoë acid fuses at  $194^\circ$ , the  $\beta$  acid at  $228^\circ$ .

**Products of the Distillation of Coal-Tar which have a High Boiling-Point.**—C. Græbe and C. Liebermann.—This memoir treats on pyren,  $C_{16}H_{10}$ , a body not to be confounded with the pyren of Laurent,



who, undoubtedly, had not obtained a pure substance, but a mixture of several hydrocarbons. The pyren here alluded to is a solid body, perfectly colourless when chemically pure; difficultly soluble in alcohol when cold, more readily so when boiling, and best soluble in benzol, ether, and sulphide of carbon; fuses at  $142^{\circ}$ . Pyren is characterised by combining directly with picric acid when solutions of these bodies are mixed together; this compound,  $C_{16}H_{10} + C_6H_2(NO_2)_3OH$ , crystallises in long needle-shaped red-coloured crystals. The memoir further gives an account of the substitution-products of pyren; nitro-pyren,  $C_{16}H_9(NO_2)$ ; pyren-chinon,  $C_{16}H_8(O_2)''$ ; bibrom-pyren-bromide; tribrom-pyren,  $C_{16}H_7Br_3$ ; and on the constitution of pyren expressed by a lengthy and very picturesque formula.

**On Phenyl-Ether and Diphenyl-Oxide.**—W. Hoffmeister.—Phenyl-ether is a solid, colourless body, having an agreeable aromatic smell; fuses at  $28^{\circ}$ ; boils at  $248^{\circ}$ ; is insoluble in water, but readily soluble in alcohol and ether. When this ether is acted upon by strong sulphuric acid, heat being applied, the result is the formation of phenyl-oxide bisulpho acid. The baryta salt of this acid—



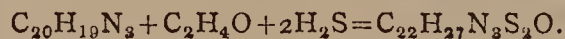
is readily soluble in water, but not in alcohol and ether. Diphenyl-oxide.—This body was prepared by the author, and its properties investigated with the view to compare his results with those obtained by M. Lesimple (see *Ann. der Chem. und Pharm.*, vol. cxxxviii., p. 375). The author confirms the correctness of the researches published in the periodical just quoted, and states that the formula of diphenyl-oxide is  $C_{12}H_8O$ .

**Quadri-Phenylised Ethylen, a Derivative from Benzophenon.**—Arno Behr.—The author describes the preparation of benzophenon from benzoate of lime; and also the conversion of the benzophenon into a chloride of that substance, by heating it along with pentachloride of phosphorus to  $180^{\circ}$ , in a sealed tube for about eighteen hours time. This chloride yields, when decomposed by finely-divided metallic silver, a new body, the quadri-phenylised ethylen,  $C_{26}H_{20}$ .

**Dibrom-Benzol.**—V. Meyer.—This paper contains a discussion on the position of the atoms of bromine in crystallised dibrom-benzol.

**Miscellaneous Researches made in the Laboratory of Berlin University.**—Dr. A. W. Hofmann.—This memoir is divided into the following sections:—On some derivatives of the isobutylic alcohol; isobutyl-benzol and isobutyl-anisol; action of bromine on the aldehyde of the ethyl series; contribution to the history of trichlor-acetic acid and trichlor-crotonic acid; action of cyanic acid on acroleine; action of chlorine upon hydrocyanic acid in alcoholic solution. The subjects herein alluded to are the results of the labours of several students who attend Dr. Hofmann's classes.

**Miscellaneous Researches.**—Dr. A. W. Hofmann.—This series contains the following subject-matter:—Aldehyde green.—The formula of this substance is  $C_{22}H_{27}N_3S_2O$ ; it may be considered as formed by the union of 1 molecule of rosaniline, 1 of aldehyde, and 2 of sulphuretted hydrogen, which, by the action of aldehyde upon rosaniline in the presence of hyposulphite of sodium, may probably be according to—

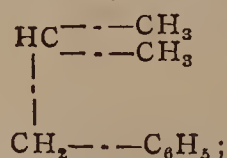


(The eminent author desires it to be stated that he does not consider this formula as expressing the true composition of the aldehyde green, but merely an approximative expression; his researches on this subject are not yet complete.) Contribution to the history of the ethylen bases. Action of cyanogen on aniline. Action of cyanogen upon triphenyl-guanidine. New series of cyanic acid ethers. New method of formation of isonitrile. Diagnosis of primary, secondary, and tertiary amines. Delicate test for chloroform.—This test is based upon the fact that, when chloroform is mixed with aniline and an alcoholic solution of caustic soda, a very strong reaction takes place, and isonitrile is generated, which is readily recognised by its peculiarly characteristic smell; this reaction is so delicate that, when 1 part of chloroform is mixed with from 5000 to 6000 parts of alcohol, the first-named substance is readily detected. Reagent for cyanuric acid when present in diluted solutions and in very small quantity.—This test is based upon the very difficult solubility of the sodium cyanurate in a hot and concentrated soda solution. Action of acetic acid upon phenyl oil of mustard (*phenylsenföl*).

**Contribution to our Knowledge on Phenyl-Xantho-Genamide.**—Dr. A. W. Hofmann.

**Separation of the Ethyl Bases from each other by means of Oxalic Ether.**—Dr. A. W. Hofmann.—These memoirs, and most of the preceding papers of this eminent author, are too lengthy to admit of any useful abstraction.

**Isobutyl-Benzol and Isobutyl-Anisol.**—J. Riess.—This memoir treats on the constitution of isobutyl-benzol—



on para- and orthonitro-isobutyl-anisol; and on the question, how the group  $NO_2$  is placed in some of these nitro-substitution compounds.

**Contribution to the History of Trichloro-Acetic Acid and Trichloro-Crotonic Acid.**—W. E. Judson.—This exceedingly lengthy monograph is divided into the following sections:—Trichlor-acetanilide; trichlor-acetoluide; trichlor-acetic acid isobutyl-ether; trichlor-crotonic acid; trichlor-crotonic acid ethyl-ether; chloride of trichloro-crotonic acid; trichloro-crotonamide; decomposition compounds of trichloro-crotonic acid; action of pentachloride of phosphorus on croton-chloral.

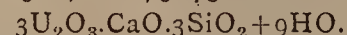
**Products of the Action of Chlorine upon Aldehyde.**—G. Krämer.—This paper contains a lengthy discussion and refutation of observations made by M. Wurtz on the author's labours on this subject, as published some time ago.

**Methods of Water Analysis.**—A. Müller.—Second paper on this subject, treating of the estimation of sulphuric acid and chlorine.

**Amido-Toluylen-Sulpho Acids.**—H. L. Buff.

**Molecular Heat of the Hydrates of Sulphuric Acid, and on the Heat of Combination Evolved by their Admixture with Water.**—L. Pfaundler.—A series of figures arranged in tabulated form.

**Uratonil.**—Dr. Krejci.—The subject referred to is the name given to a new mineral first found near Sedlec, Bohemia, but lately also near Welsendorf, Bavaria. This mineral does not fuse when heated in the blowpipe flame; it consists, in 100 parts, of—Water, 12.666; silica, 13.781; phosphoric acid, 0.448; sesquioxide of uranium, 66.752; alumina and peroxide of iron, 0.511; lime, 5.273. Formula—



**Cotton Dressing.**—O. Meister.—The author, residing at Zürich, Switzerland, states that a parcel of white calico, of English manufacture, was found, on analysis, to be dressed to the extent of over 25 per cent of the weight of the fibre, while 5 per cent of this dressing consisted of mineral matter. The calico was sold at a price below the value of the yarn it was made of.

**Adulterated Starch.**—O. Meister.—A sample of starch sent (not, however, from England, but from Germany) to a dresser of calicoes, &c., at Zürich was found to be adulterated with 16 per cent of gypsum.

**Establishment of a Chemical Society at Zürich.**—The last-named author communicates that (now some months ago) the company hitherto existing under the title of Chemical Harmonica has been converted into a regularly-established chemical society, under the presidency of Dr. Wislicenus. The papers read at this Society and the communications made will be published in the above-named periodical until further notice. The Society lost, a few weeks after having been inaugurated, one of its foremost members, by the death of Dr. A. P. Bolley, whose biography forms the concluding pages of this number.

*Polytechnisches Journal von Dingler*, second number for September, 1870.

This number contains the following original papers relating to chemistry and collateral sciences:—

**Detection of Arsenic in Sulphuric and Hydrochloric Acids, in Subnitrate of Bismuth, and in Antimonio-Tartrate of Potassa.**—Dr. A. Bethendorf.—Take a thoroughly clean and dry test-tube, of not too narrow a bore; put into it as much pure protochloride of tin as can be placed on the point of a knife; next add from 4 to 6 c.c. of pure hydrochloric acid (containing 25 per cent of real acid, sp. gr. about 1.12); add, after this, gradually, from 2 to 3 c.c. of the sulphuric acid to be tested, taking care to move the test-tube very gently. If a white precipitate ensues, the addition of a few drops of the hydrochloric acid will be required to restore the liquid to perfect limpidity. If no arsenic is present, the liquid remains clear and colourless, even after standing for a time; but, if even a trace of arsenic is present, the fluid becomes at first yellowish, next brownish coloured, and at last the metallic arsenic is deposited as a deep greyish brown flocculent substance. Even with only 1-500,000th part of arsenious acid a colouration ensues. It is essential that, when the sulphuric acid is added, the liquid should become hot; if, therefore, that acid is too dilute to cause heating, the test-tube and contents should be warmed over a spirit flame. The testing of hydrochloric acid only differs in this particular: that, instead of taking, as above stated, pure hydrochloric acid, the acid to be tested is taken, and pure concentrated sulphuric acid is applied. The testing of the subnitrate of bismuth is carried out in the following manner:—About  $\frac{1}{2}$  a grm. of the subnitrate is placed in a test-tube; a quantity of 1 c.c. of pure and concentrated sulphuric acid is next added, to expel the nitric acid. After this has been driven off, the tube being kept in a vertical position, from 4 to 5 c.c. of pure hydrochloric acid are added; when the liquid has become quite clear, about 1.5 to 2 grms. of pure protochloride of tin are added; after this salt has been dissolved, about 3 c.c. of strong and pure sulphuric acid are added; and, if the mixture does not then become very hot, it is heated just to the boiling-point. The colouration and precipitation of arsenic above described take place after a shorter or longer time, according to the quantity of that substance which is present; but it ought, of course, to be absent. The testing of tartar emetic is effected in the following manner:—As much tartar emetic as can be carried on the point of a large-sized knife, and twice as much protochloride of tin, are placed in a wide test-tube; 4 to 5 c.c. of the pure hydrochloric acid above alluded to are added; and, next, 2 to 3 c.c. of pure concentrated sulphuric acid. If required, the mixture is heated. Neither the oxides of bismuth nor antimony are reduced to the metallic state by this reaction.

**Solubility of Sulphur in an Aqueous Solution of Carbonate of Soda and in Linseed Oil.**—Dr. J. J. Pohl.—The author experimented with flowers of sulphur, previously well washed and dried at  $100^{\circ}$ , and with an aqueous solution of pure anhydrous carbonate of soda containing 5.6 per cent of salt. Sulphur was found to be insoluble in that solution at  $25^{\circ}$ ; but, when the sulphur was digested with the aforesaid solution, heated to  $100^{\circ}$  for a period of ten hours, it was found, on testing the soda solution, that the quantity of sulphate of baryta obtained corresponded, on an average, to a quantity of 0.0676 per cent of sulphur dissolved. The solubility of sulphur in linseed oil increases with the increase of temperature—at  $25^{\circ}$ , linseed oil dissolves 0.63 per cent of sulphur; at  $95^{\circ}$ , 2.587; at  $130^{\circ}$ , 4.935; and at  $160^{\circ}$ , 9.129 per cent. Linseed oil which has taken up that quantity of sulphur keeps dissolved,



even after having been standing for a fortnight at 20°, 6.9 per cent; and even after ten weeks' time, no more sulphur is deposited than occurs at first.

**Occurrence of Raw Sugar which contains Dextrine, and on the Detection and Estimation of that Substance.**—Dr. C. Schiebler.—The author states, in this lengthy paper, chiefly the following facts:—That now and then raw beet-root sugar contains dextrine; that alcohol is not an absolute test for the presence of this substance, while iodine in dilute solution is a better test. In order to test for the presence of dextrine in raw sugar, the author proceeds as follows:—13 grms. of the sugar in question are dissolved in 50 c.c. of water. This solution is filtered, and a portion thereof is mixed with about four times its bulk of alcohol at 95 per cent, which, if dextrine is present, produces a milky cloudiness in the fluid. Another portion of the liquid is treated with a solution of iodine, consisting of 0.1 grm. of iodine and 1.5 grms. of iodide of potassium, dissolved in a little water, and next diluted to 100 c.c. This solution, which is of a sherry colour, produces the characteristic colouration (purplish red) if dextrine be present; but, if the sugar solution is alkaline, the first drops of the iodine solution do not produce a colouration at once. The quantitative estimation of the dextrine can only be effected by analysing the sugar, after having been treated with dilute sulphuric acid, and next applying the well-known copper liquid test.

**Addition of Poisonous Substances to Bread.**—Dr. H. Eulenberg and Dr. H. Vohl.—This paper, too lengthy for any useful abstraction, treats on the adulteration of bread by the addition thereto of sulphate of alumina, alum, and the sulphates of copper and zinc, and on the methods of testing for the presence of these substances in bread.

**Application of Tungstate of Soda to form an Elastic Mass.**—Dr. Sonnenschein.—When glue, in thick solution, is mixed with tungstate of soda, and hydrochloric acid is added, there is thrown down a compound of tungstic acid and glue, which, at from 30° to 40°, is so elastic as to admit of being drawn out into very thin sheets. On cooling, this mass becomes solid and brittle; but, on being heated, it becomes again soft and plastic. This material has been successfully employed, instead of albumen, in calico-printing, in order to fix the aniline colours upon cotton; the further applications of this substance are in tannin, but the resulting leather becomes as hard and stiff as a plank of wood. The preparation is recommended as a lute or cement.

*Journal für Praktische Chemie*, No. 15, 1870.

The following original papers and memoirs are contained in this number:—

**Relation between the Crystalline Shape and the Chemical Constitution of some Organic Compounds.**—Dr. P. Groth.—The continuation and end of this lengthy essay.

**Lithiophorite, a Manganese Ore containing Lithia.**—A. Frenzel.—The mineral here alluded to was first found, some years ago, in the neighbourhood of Schneeberg (Saxony), and considered as being psilomelan. The author, however, having investigated this substance, gives the following facts about it:—Sp. gr., 3.14 to 3.36; hardness, slightly above that of calcareous spar; colour, bluish black; amorphous; gives off water when heated in a test-tube, and evolves chlorine when heated in the presence of hydrochloric acid; does not fuse when heated before the blowpipe, but imparts to the flame an intensely carmine-red colour; fused along with borax or microcosmic salt, it yields the characteristic tests for manganese. A full analysis of this mineral will be published afterwards; the author now only gives the following particulars:—Lithia, 1.15 per cent; alumina, 15.42 per cent. This mineral is, says the author, a product of decomposition, but, for all that, a new and specific mineral.

**Isotrimorphism of Oxide of Tin and of Titanic Acid, and on the Crystalline Form of Zirconia.**—G. Wunder.—A crystallographical essay.

**Chemical Constitution of the Phosphorus-Platinum Compounds described by MM. A. Cahours and A. Gal in Comptes Rendus (vol. lxx., pp. 897, &c.).**—Dr. H. Kolbe.

**Isotaurine.**—M. Kind.—This paper, a preliminary notice, contains the announcement that the author has discovered a new body, which, on being analysed, led to the following formula:— $C_2(H_4, H_2N)SO_2OH$ . He has named it isotaurine, and promises further particulars.

**Amido-Sulpho-Phenol.**—L. Glutz and L. Schrank.—This paper is also a preliminary notice. The authors describe, at some considerable length, the methods by which they have obtained, from the sulphaniidic acid of the nitrophenyl-sulphuric acid, several other compounds, among these, nitrophenyl-sulphuric acid chloride (*nitrophenyl-schwefelsäure chlorid*),  $(C_6H_4NO_2)SO_2Cl$ , a crystalline body, insoluble in water, soluble in ether, and also in boiling alcohol, although it becomes partly decomposed thereby, and fuses below 100°. By acting upon this body with metallic tin, the authors have obtained the hydrochloride of the amido-sulpho-phenol,  $(C_6H_4NH_2)SH.HCl$ .

**Bromonitro-Benzol-Sulpho Acid and some of its Derivatives.**—F. G. Fricke.—This paper, again styled preliminary notice, contains the following sections:—Action of ammonia upon bromonitro-benzol-sulpho acid; action of potassa upon bromonitro-benzol-sulpho acid; action of aniline upon bromonitro-benzol-sulpho acid.

**Water of Crystallisation.**—F. von Kobell.—A lengthy monograph on this subject.

**Influence which Temperature Exerts on the Molecular Power of some Substances Endowed with the Property of Circular Polarisation.**—Dr. C. Tuchschnid.—This very lengthy essay is illustrated with engravings and a series of tables containing a large number of figures.

*Pharmaceutische Zeitschrift für Russland*, No. 4, 1870.

This number contains the following original papers and memoirs:—

**Some Narcotics Used by the Inhabitants of Central Asia.**—Dr. Palm.—This paper contains a brief notice on *Buhsa*, a fluid which appears to possess highly intoxicating power; so much even, that, according to the author's statement, the Russian military authorities have been obliged to forbid the preparation of this beverage, which, being in great favour with the troops, and preferred to other spirituous fluids, renders the men unfit for duty in a very short time. *Buhsa* is prepared by the Kirghisen in the following manner:—Millet is rubbed to a pulp with water; and, after having been diluted with more water, and occasionally with mare's milk (this milk is largely used by the inhabitants of Central Asia), the mixture is poured into large stoneware jars, which are tightly corked, and afterwards buried in the soil. The vessels containing the liquid are left imbedded therein for about ten days; and, after having been dug up, the fluid is transferred to glass wine-bottles, which, after having been well corked, are left standing for a few days, and then offered for sale at the rate of from 3 to 5 kopeïks each (6d. to 10d.). The liquid thus prepared exhibits a greyish colour (somewhat akin to thin barley-water), and is turbid, there being a thick sediment in the bottles. On being uncorked, supposing the liquid to be matured, the beverage escapes in a very brisk manner, owing to the large quantity of carbonic acid present. The taste of this fluid is tart and spirituous; but the after-taste is very unpleasant, owing to the presence of fusel oils. Although the ingredients from which this drink (millet beer) is prepared are somewhat innocent, the effects of the imbibing of this fluid upon the system are not by any means mild; these the author refers to the presence of the alcohols of the higher fatty acids, in addition to alcohol, aldehyde, acetic, lactic, valerianic, and traces of fatty acids and their alcohols (viz., fusel oils). Notwithstanding the Russian Government takes all possible measures to prevent the preparation and sale of *buhsa*, it is a popular drink; and, moreover, its mode of preparation from millet yields a substitute for yeast for baking purposes, and the prepared *buhsa* is largely applied for that purpose. The author next treats on three kinds of opium. That locally known as Bucharic opium is not the product of Central Asia, but imported overland from Hindostan; the two other kinds (viz., Chinese and Samarkand drugs) were found of good quality. The *Haschisch*, or *Chaschisch*, from *Cannabis indica*, is next alluded to; it is used in various forms, and by the Mahomedan women, in the shape of lozenges, known as *goëlkant*, which literally means yellow sugar, but consisting of sugar, haschisch, cinnamon, ginger, pepper, cloves, and gum.

**Analysis of a Crude Potash.**—Dr. Palm.—At a distance of 80 wersts from Taschkent (the werst is a Russian measure, equal to 1066.78 metres; 104.1555 wersts are equal to 1 degree of the meridian) the Kirghise prepare, from various wild plants, a kind of potash which occurs in the trade (in Central Asia) as a hard kelp-like substance, very difficultly soluble in boiling water, and leaving a carbonaceous residue. The author found this substance to contain, in 100 parts:—Carbonaceous matter, 5; soda, combined with carbonic acid, 36.8; chloride of sodium, 7.3; lime, 5.5; potassa, 3.85; magnesia, 1.4; alumina, 0.64; carbonic acid, 26.12; chlorine, 11.26; sulphuric acid, 1.84; silica, 0.05; iron and manganese, traces. The author calls attention to the fact that the large percentage of soda in this material is due to the very generally prevailing impregnation of the soil of the steppes, for thousands of wersts in extent, with carbonate of soda and chloride of sodium. The shrubs and plants which serve to prepare this article are such as can only grow in a similar soil.

**Preliminary Notice on the Milky Juice of an Euphorbiaceous Plant.**—Dr. Palm.—After referring to some strictly botanical particulars concerning a plant found in the neighbourhood of Taschkent, the author states that the milky juice which this vegetable yields while being cut is at first perfectly homogeneous; but, in a few minutes, more than three-fourths of the bulk of this fluid becomes coagulated—that is to say, the caoutchouc which is nearly always present, in greater or less quantity, in all milky vegetable juices separates, leaving a fluid which exhibits, simultaneously, an ammoniacal and ethereal odour. The caoutchouc, once separated from its menstruum, cannot be united with it any more. The taste of this milky juice is at first mild and oily, but soon leaves an acrid, sharp, burning taste, which even brings on inflammation of the throat. Our readers are reminded that all euphorbiaceous plants are more or less poisonous, while some among them yield the most virulent acrid vegetable poisons we are acquainted with.

No. 5.

This number contains the following original papers and memoirs:—

**The Manner in which the Nitrogen is Distributed in the Different Parts of the Black and White Henbane (*Hyoscyamus Niger et Albus*) during the various stages of the Development of these Plants.**—E. Thorey.—This lengthy monograph contains the results of a long series of experiments made with the above-named plants, as a whole, and their different parts—viz., roots, leaves, stems, seeds—and at various periods of their growth, with the view to ascertain the partition of the various nitrogenised constituents of these plants at various epochs of their life. The essay is too lengthy, and too much filled with a series of results exhibited in tabulated form, to admit of any useful abstraction, notwithstanding the great value of this labour in a photo-physiological point of view, as well as in its practical bearing of the applications made of *hyoscyamus* in medicine.

No. 6.

This number opens with and contains no other original paper than—



**Treatise on the Various Analytical Methods in Use for the Determination of the Quantity of Tannic Acid present in Catechu, Ratanhia, Kino, and other Drugs.**—Dr. Günther.—This exhaustive monograph, the first portion of which is found in this number, and is continued in Nos. 7 and 8, contains a review of all the various methods which have been proposed for the estimation and quantitative determination of the tannic acid present in the commercial substances above referred to, and chiefly applied in dyeing, calico printing, and tanning. The author not only describes the various methods, but has tested the value of each method practically and with great care. Among the results arrived at, and the conclusions drawn from his researches, we quote the following as the most important:—None of the different methods which have been applied for the quantitative estimation of tannic acid answers the purpose completely—that is to say, that a method which yields excellent results with nutgalls is not equally suitable for sumack, cutch, and other similar substances; for the reason that these materials contain either other substances along with tannic acid or specific modifications of the same. We regret that the very great length of this monograph prevents us entering into further details on this subject.

Nos. 7 and 8.

These numbers contain no other original papers than that quoted under No. 6.

No. 9.

This number contains the following original papers and memoirs:—

**Contribution to our Knowledge of the Aconite Alkaloids.**—Dr. F. A. Flückiger.—This paper treats on the alkaloids contained in several plants known by different botanical names, but all belonging to the species *aconite*. The author distinguishes between aconitine, pseudoaconitine, napelline, and lycoctonine. The first of these alkaloids is the most important, and possesses, among others, the following properties:—It becomes soft and pasty in boiling-water, and imparts to phosphoric acid, when evaporated along with that substance to a syrupy consistence on a water-bath, a violet colour, which remains even for days after the cooling of the mass. The aqueous solution of aconitine has a bitter taste, but not acrid; the solution is not precipitated by chloride of platinum, but the solution of the double salt of iodide of potassium and iodide of mercury produces, in such solutions, a copious non-crystalline precipitate. Aconitine is very soluble in ether, chloroform, and alcohol; it is anhydrous; its nitrate crystallises readily. Pseudoaconitine does not become pasty in hot water, and does not exhibit the reaction with phosphoric acid above alluded to; it is very difficultly soluble in water, ether, alcohol, and chloroform; and crystallises better (in large prismatic-shaped crystals) than aconitine.

## NOTES AND QUERIES.

**Tabachere.**—Can any of your readers give me information as to the chemical composition and properties of this substance. It is said to be produced from the bamboo.—WM. LANT CARPENTER.

**Anthracene.**—(Reply to "H. J.")—The large manufacturing firm of Messrs. Gehe and Co., at Dresden, forward us their price lists, published quarterly; in their list for September, the price of anthracene is quoted at 2 Rths. per pound, equal to about 6s. 6d. English currency.

**Ethers in Wine.**—Can any of the readers of "Notes and Queries" inform me where I shall find Berthelot's formula for calculating the amount of the compound ethers contained in wine, and also the method pursued for the estimation of those ethers?—H. T. B.

**Hydrogen Apparatus.**—T. A. White wants to know how to use a "hydrogen apparatus," said to be Woolfe's, having a cylinder for generating hydrogen, with a blowpipe attached to it underneath, in a drawer, in the front of which is a small spirit-lamp to ignite the hydrogen jet.

**Black Japan.**—(Reply to "S. R. H.")—We have not space to enter into particulars on this subject; you are referred to the "New York Coach-Makers' Monthly Magazine," and to Cooley's "Cyclopædia of Practical Receipts," both of which works may be inspected at the Library of the Commissioners of Patents.

**Estimating Cyanides.**—(Reply to E. Outhet.)—Since cyanides are very readily decomposed by acids, and since the substances employed to make the brown sulphate of ammonia are saturated with acid previous to evaporation, it is hardly likely that any cyanide should be left undecomposed in the crude sulphate of ammonia; but, should there be any left, you will be enabled to estimate it by the methods fully described in the fifth edition of Dr. Fresenius's "Quantitative Chemical Analysis," edited by A. Vacher, page 170 and following.

## TO CORRESPONDENTS.

**E. Kernan.**—There is an English edition published in America.

**C. E. Craven.**—(1) The work will not be ready for some time to come. (2) We do not know of such a work in English.

**Querist.**—Mr. Wanklyn is not a foreigner. On referring to Poggenдорff's "Biographical Dictionary," we find that he was born at Ashton-under-Lyne, near Manchester. Last year he was elected a Corresponding Member of the Munich Academy of Sciences.

**Vox.**—(1) The Royal School of Mines is in Jermyn Street, W. (2) Dr. Yeats's book, reviewed in No. 568 of our journal, is the only work we know of treating on the subject.

**B. W. Gibsons.**—Received.

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# THE CHEMICAL NEWS.

VOL. XXII. No. 571.

## ON THE SOLVENT POWER OF ANHYDROUS LIQUID AMMONIA.\*

By Professor CHARLES A. SEELY, of New York.

PROFESSOR SEELY states that he has made the discovery that ammonia has a solvent power upon certain metals, and that he has actually succeeded in obtaining a solution of sodium in liquid ammonia. This solution presents all the physical characteristics of a true solution. On evaporation, the sodium is gradually restored to the metallic state in the same continuous manner in which the solution has been affected. The colour of the solution is a very intense blue, and its opacity or high tinctorial power is urged as an argument in favour of the notion that the metal is in simple solution. Weyl had made the capital discovery that when gaseous ammonia is condensed by pressure and cold on sodium, a blue liquid is the product, but he had mistaken the nature of this product. Professor Seely has experimented on various substances, and has concluded that ammonia is a solvent of metals; that other metals can be dissolved in ammonia, and the details of his experiments in confirmation of the views, will be the subject of another paper.

## ON EDIBLE EARTH.†

By Prof. C. W. C. FUCHS.

To the list of the earth-eating people the Javanese must be reckoned; a fact brought to our knowledge by Alex. von Humboldt. From the specimens which I have had the opportunity of seeing, it is to be inferred that earths of very different external appearance and of different character are eaten. One deposit of such edible earth, possessing an intensely red colour, exists in the neighbourhood of Sura Baja, between strata referable to the time of the latest tertiary.

This earth is formed into thin cakes, having a diameter of from 1—1½ inches; it is then dried over an open fire, and in this condition is brought into the market. It is perfectly smooth to the touch, and is composed of materials in the finest state of subdivision. By a chemical analysis, to which I subjected it, after removing the thin stratum of soot, which settles upon it during the process of drying over the fire, I convinced myself that it does not contain the slightest trace of an organic substance. The analysis gave the following result:—

SiO <sub>2</sub>	..	..	..	..	50.63
AlO <sub>3</sub>	..	..	..	..	21.32
FeO <sub>3</sub>	..	..	..	..	10.47
H <sub>2</sub> O	..	..	..	..	12.97
CaO	..	..	..	..	2.40
MgO	..	..	..	..	0.33
K <sub>2</sub> O	..	..	..	..	1.02
Na <sub>2</sub> O	..	..	..	..	0.23

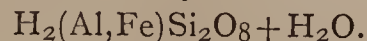
99.37

Of the water, 6.36 per cent was driven off below red heat. The remaining 6.61 per cent disappeared only when the test portion was heated to bright redness. From the analysis it is apparent that the earth consists of a clay

\* Abstract of a paper read before the American Association for the Advancement of Science, 1870.

† Communicated by Dr. W. H. Wahl. From advance-sheets of the *Journal of the Franklin Institute*.

rich in iron, in which is still retained small quantities, yet undecomposed, of the minerals from which it derived its origin. In this way the trifling percentage of potassa and soda may be accounted for. Taking away the accessory alkalies, and so much of the silica as they demand, there remains behind a clay of the formula:—



Humboldt suggested that the probable explanation of the earth-eating habit might be found in the desire to fill the stomach, and thus, in a measure, to allay the pangs of hunger. This view of the subject may be satisfactory when applied to those rude people who devour it in great quantity; but it will not apply to the case of the Javanese, who make this use of but trifling quantities. With these it is much more probable that the physical properties of the earth alone are sufficient to furnish the cause we are seeking.

Upon rubbing it, not the slightest grittiness is perceptible, and on being moistened with water it forms a smooth and unctuous mass. The enjoyment derived from eating it seems to reside in the similarity of the sensations it produces with those derived from the eating of fatty substances. In many parts of Würtemberg the quarrymen have the habit of eating the smooth, unctuous clay which collects in the fissures of the rocks. The term "Mondschmalz," which they apply to it, would seem to refer to the enjoyment they experience in the process of eating.

## ON THE CALORIFIC POWER OF HARE'S BLOWPIPE.

By W. MARSHALL WATTS, D.Sc.

THE explanation of the formula for the calculation of the temperature of the oxy-hydrogen flame, asked for by Professor Wurtz, is easy. In the combination of 1 lb. hydrogen with 8 lbs. oxygen 34,462 units of heat are produced, that is, enough heat to raise 34,462 lbs. water from 0° C. to 1° C. This heat is expended first in raising the temperature of the water produced from 0° C. to 100° C., then in converting it into steam at 100° C., and finally in raising the temperature of the steam from 100° C. to the temperature of the flame. Calling this unknown temperature  $t$  we have the equation—

$$34462 = 9 \left\{ 100 + 537 + (t - 100) 0.4805 \right\} \\ \text{whence } t = \frac{34462 - 9(637 - 48.05)}{4.3245} \\ = 6743^\circ$$

Or we may suppose the water produced first of all changed into steam at 0° C. in which case we must take the latent heat equal to 606.5, and in this case—

$$34462 = 9(606.5 + t \times 0.4805) \\ \text{whence } t = 6707^\circ.$$

## NOTES ON THE EXTINCTION AND REDUCING POWER OF MERCURY.\*

By Dr. ISIDOR WALZ.

At the last meeting of the chemical section of the Lyceum I drew attention to the conversion of liquid zinc-amalgam to a gray powder, when shaken with a solution of potassium bichromate. Subsequently I became convinced that this phenomenon was solely due to the extinction of the mercury, and have made a number of experiments regarding the phenomenon, of which I present the following results. It is hardly necessary to state that the mercury used was absolutely

\* Read before the New York Lyceum of Natural History.



pure. It is very difficult, but essential, to use chemically pure mercury, as even a very small trace of a foreign metal is often sufficient to influence the results materially. The experiments were made in ordinary test-tubes, in which the materials were shaken a length of time varying from a few seconds to 10 minutes. I believe that we ought to distinguish between two methods or kinds of extinction, namely the mechanical and the chemical. The former is effected by a very large number of solutions of neutral salts, which exert no chemical action on mercury, and even by pure water, if shaken long enough. The extinction of the mercury in this case is produced simply by the interposition of fine films of the liquid between the globules, into which the mercury is separated by the mechanical agitation, and which are thus prevented from running together again. By mechanical extinction, mercury is converted into what appears to be a fine powder, which, however, never loses its white colour and metallic appearance, and under the lens its globular structure is clearly seen.

Quite interesting in many cases are the reactions which accompany the chemical extinction of mercury, which takes place when the metal is shaken with a solution of a salt, by which it is chemically affected. In these cases, the newly-formed mercury compounds act in the same way as the films of liquid in the former instance, preventing the separate globules from re-uniting. A finer division of the metal is obtained in less time than by the mechanical method, and the resulting metallic powder is generally of a dull gray leaden colour. When a solution of potassium bichromate is poured upon mercury, the convexity of the surface is at once destroyed; presently the surface is tarnished and begins to look wrinkled, while, at the same time, a greenish-black powder commences to deposit itself. This greenish-black powder is a mixture of chromic and mercurous oxide; it is formed abundantly when the two liquids are agitated more or less strongly; the mercury is at the same time completely extinguished, and at the end of the reaction neutral potassium chromate alone remains in solution, which is not acted upon by mercury. Ferric chloride extinguishes mercury; ferrous and mercurous chlorides are formed. Potassium permanganate also acts upon the metal; manganic and mercurous oxides are deposited, while potassic hydrate remains in solution. Mercury shaken with Fehling's solution is simply extinguished mechanically, when all the reagents used are pure; but when a very small quantity of zinc-amalgam is added,  $\text{Cu}_4\text{O}$  is reduced from the solution.

A solution of potassium ferricyanide does not affect the fluidity of mercury; but when the two are shaken together, a green powder is formed in large quantities, which, if allowed to stand, changes to a dark, and later still to a light, blue colour. Potassium ferrocyanide appears to be formed at the same time. I am still engaged in studying this interesting reaction, and will endeavour to determine if this blue powder is Prussian blue or not. Sodium hyposulphite, also, does not affect the mercury physically; on agitation, however, a heavy black powder, mercuric sulphide, is formed. Its amount increases with the lapse of time, and in one of my test-tubes, which has hardly been disturbed for weeks, the original black sulphide has assumed a yellowish red colour.

I conclude from these observations that the reducing power of pure mercury is greater than is generally supposed, and I expect to be enabled to obtain some interesting results from an extension of these experiments.

I have repeated some of Loew's experiments, which he described at our last meeting, and can state that similar results are obtained by substituting palladium bichloride for the platinum salt. I cannot, however, yet coincide with him in considering his final product as hydrogenium-amalgam, as by every method by which it has yet been made it contains another metal besides mercury and hydrogen, namely, either platinum, palladium, gold, or silver, in no inconsiderable proportion.

## SPECTROSCOPIC NOTES.

By Prof. C. A. YOUNG, Ph.D., of Dartmouth College.

*Spectrum of a Solar Spot, April 9, 1870, P.M.*

EXAMINED the spectrum of a large group of spots a little north and east of the sun's centre.

The nucleus of the most southerly member of the group reversed the C line finely, turning it into a conspicuous bright line for about 20" of its length, without any distortion, however, such as is common upon this (dark) line in the neighbourhood of spots.

F was also reversed, but rather faintly.

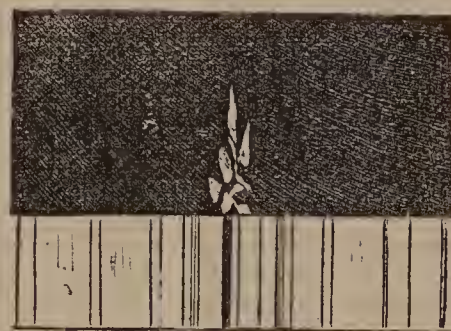
$\text{D}_3$  could not be made out at all in the nucleus spectrum; neither were 2796 (the numbers refer to Kirchhoff's map) nor  $h$  reversed. I thought, however, that they were somewhat *thinned*.

The reversal of C and F continued through the whole afternoon.

On the other hand, many of the dark lines were widened and deepened in this nucleus spectrum in the manner which the description and figures of Mr. Lockyer have made familiar. Many also were unaffected. Among these were notably  $\alpha$ , B, E, 1474, the four lines of  $b$ , 1691 and G.

The two sodium lines  $\text{D}_1$  and  $\text{D}_2$ , and 850 (Fe) were distinctly, but not greatly, widened.

The effect was most marked upon the following:—864 (Ca), 877 (Fe?), 885 (Ca), 895 (Ca and Li), 1580 (Ti), 1599 (Ti), 1627 (Ca), and 1629 (Ti). I have marked 877 doubtful, because there lies very near it a line whose origin is



unknown, and I am not sure to which of the two the thickening was due. The Titanium lines are identified as such by reference to Angström's atlas. I was greatly surprised at the prominence they assume in the spot-spectrum, as they are inconspicuous in the normal spectrum; and a similar remark applies to the calcium lines.

I do not intend to convey the idea that the lines mentioned were the only ones that were much deepened; there were many others, mostly faint, affected to nearly the same degree, but I had not time to identify them.

There was, at the same time, an exceedingly brilliant protuberance on the south-west limb of the sun (position angle  $230^\circ$ ), near, but not over, a large spot which was just passing off. At the base of this prominence, which was shaped like a double ostrich plume, the C line was intensely brilliant, so that the slit could be opened to its whole width in studying the form above described, but it was not, so far as I could see, in the least distorted. On the other hand, the F line, also very brilliant, was shattered all to pieces, so that at its base it was three or four times as wide as ordinary, and several portions of it were entirely detached from the rest. The figure, without pretending to exact accuracy, and for the sake of distinctness a little exaggerated, gives a fair idea of the nature and extent of the "shattering" alluded to.

Since the C line was not similarly affected, it is hardly possible to attribute this breaking up of F to cyclonic motions in the gas from which the light emanates, and it becomes very difficult to imagine a cause which can thus disturb a single line of the spectrum by itself. Possibly this appearance may be the result of local absorptions acting upon a line greatly widened by increase of pressure or temperature.



It continued unchanged for more than half an hour, and until the sun passed out of sight behind a building. The observations were made with the 5-prism spectro-scope.—*Journal of the Franklin Institute.*

## NOTES OF CONTRIBUTIONS TO MINERALOGICAL CHEMISTRY.\*

By Prof. A. H. CHURCH, M.A.

I AM anxious to draw the attention of the chemical section to the special features of certain mineralogical researches on which I have been engaged for the last six years. I have had three objects chiefly in view.

- (1.) The elucidation of obscure minerals by exact and minute analysis.
- (2.) The discovery of new species and varieties.
- (3.) The chemical structure of minerals.

Besides the direct determination of every ingredient of a mineral, I have been led to consider the mode of desiccation of a mineral as of the very highest importance to the attainment of satisfactory results. When I commenced, in 1864, one series of experiments, "the revision of the mineral phosphates," I wrote, "If chemists had invariably analysed natural phosphates in the same manner as the preparations of the laboratory, the discrepancy in the above results could scarcely have occurred. Many other hydrous minerals are in the same predicament—the hygrometric condition at the time of analysis has not been determined." In numerous instances I have been able to throw much light upon the constitution of a mineral, and also to explain the most singular anomalies and divergences in earlier analyses by simply drying the specimen previous to analysis, first over oil of vitriol *in vacuo*, then at 100°, and then at gradually increasing temperatures. I have drawn up in a compact form, and in alphabetical order, a brief account of some of the chief minerals, new, rare, anomalous, or obscure, which I have lately analysed. Many of the results have been already published, but several new analyses are included. The several series which are still being continued are—

Revision of the mineral phosphates.  
Chemical researches on new and rare Cornish minerals.  
Mineralogical notices.

*Atacamite*.—New to Britain.  
*Bayldonite*.—New to science.  
*Calaite*.—Revision of formula.  
*Chalcophyllite*.—Revision of formula.  
*Childrenite*.—Revision of formula.  
*Chloropal*.—New to Britain.  
*Churchite*.—New to science.  
*Cornwallite*.—Revision of formula.  
*Delvauxite*.—Revision of formula.  
*Dufrenite*.—Revision of formula.  
*Hisingerite*.—New to Britain.  
*Limnite*.—Analysis of a remarkably pure specimen.  
*Melanconite*.—New form.  
*Namaqualite*.—New to science.  
*Pagodite*.—New analyses.  
*Restormelite*.—New analyses.  
*Tallingite*.—New to science.  
*Tasmanite*.—New to science.  
*Tavistockite*.—New to science.  
*Woodwardite*.—New to science.

In addition to the minerals named above, experiments have been made upon several others, the results of the analyses having been published in some instances, in others being reserved till more conclusive. These minerals are:—

Autunite.  
Brochantite.  
Devilline.  
Langite.  
Ehlite.  
Marmatite.  
Phosphochalcite.  
Prasine.  
Torbernite.

*Atacamite*,  $\text{CuCl}_2, 3\text{CuO}, 4\text{H}_2\text{O}$ ; or  $\text{CuCl}_2, 3\text{CuH}_2\text{O}_2, \text{aq.}$ —This species is found in Wheal Cock, near Wheal Botallack, Cornwall. Until I identified specimens from that locality it does not appear to have been recognised as a British mineral. The experimental and theoretical percentages are here compared.

	Experiment.	Theory.
Cu .. ..	13.57	14.3
Cl .. ..	15.20	16.0
CuO .. ..	54.32	53.6
H <sub>2</sub> O .. ..	16.91	16.2
	100.00	100.0

For details see *Journ. Chem. Soc.* (2), iii., pp. 81, 213; Dana's "Mineralogy," 5th ed., p. 121.

*Bayldonite*,  $\text{PbCu}_2\text{AsO}_4, \text{CuH}_2\text{O}_2, \text{aq.}$ —This lead and copper arseniate is a distinct species, first recognised in 1865. It is by no means a rare material, many specimens occurring in old collections of Cornish minerals under erroneous designations. It presents the appearance of minute mammillary concretions with a drusy surface: its density is 5.35, and its hardness 4.5; its analytical and theoretical percentages are as follows:—

	Experiment.	Theory.
PbO .. ..	30.13	30.7
CuO .. ..	30.88	32.8
As <sub>2</sub> O <sub>5</sub> .. ..	31.76	31.6
H <sub>2</sub> O .. ..	4.58	4.9
Loss .. ..	2.65	—
	100.00	100.0

For further details see *Journ. Chem. Soc.* (2), iii., p. 265 Dana's "Mineralogy," 5th ed., p. 565.

*Calaite*,  $\text{AlPO}_4, \text{AlH}_3\text{O}_3, \text{aq.}$ —The true Persian turquoise has been analysed with rather perplexing results. But if the intruding copper, iron, and manganese phosphates be excluded, the composition of the true basis of the turquoise is arrived at. The direct analytical results establishing the true formula of this species are here given.

	Experiment.	Theory.
P <sub>2</sub> O <sub>5</sub> .. ..	32.86	32.6
Al <sub>2</sub> O <sub>3</sub> .. ..	40.19	46.9
CuO .. ..	5.27	—
FeO .. ..	2.21	—
MuO .. ..	0.36	—
H <sub>2</sub> O .. ..	19.34	20.5
	100.23	100.0

For further details see CHEM. NEWS, vol. x., p. 290.

*Chalcophyllite*—

$\text{Cu}_2\text{H}_2\text{AsO}_4, 4\text{aq.}, 6\text{CuH}_2\text{O}_2, \text{Al}_2\text{H}_6\text{O}_6, 11\text{aq.}$ —Chalcophyllite, the tamarite of Brooke and Miller, has been often analysed with most contradictory results. By numerous trials I found that part of its water (11 aq. above) was held much less tenaciously than the rest, and that it invariably contained a definite amount of alumina. The foregoing revised formula represents the results of my analyses.

	Experiment.	Theory.
CuO .. ..	46.14	44.82
Al <sub>2</sub> O <sub>3</sub> .. ..	5.97	7.26
As <sub>2</sub> O <sub>5</sub> .. ..	15.54	16.21
H <sub>2</sub> O .. ..	31.75	31.71

Further details in *Journ. Chem. Soc.* (2), viii., p. 168.

*Childrenite*.—As yet I am unable to speak with confidence as to the true constitution of childrenite: I have made many analyses of the mineral, but the samples picked for analysis, though selected fragment by fragment, under the microscope, contained, besides one per cent of

\* Read before the British Association, Liverpool Meeting, Section B.



silica, evident traces of chalybite. I have, however, learnt that the only analysis of the mineral yet published is too low in the phosphorus pentoxide and too high in the ferrous oxide, that a part of the iron is in the ferric condition, and that the formula suggested by Rammelsberg will have to be modified.

*Chloropal*,  $\text{Fe}_2\text{O}_3\cdot 3\text{SiO}_2\cdot 5\text{H}_2\text{O}$ ?—I first detected chloropal, in England, in 1865, in seams of granite in a quarry about three-quarters of a mile from the old tin mine of Carclaze, St. Austell; it has since been found in abundance in other parts of Cornwall. The state of oxidation of the iron varies; there is always some in the ferrous condition. The water is partly held in a state which the heat of the water-oven suffices to alter; the formula of this mineral thus dried is probably  $\text{Fe}_2\text{O}_3\cdot 3\text{SiO}_2\cdot 3\text{aq}$ . Some specimens contain a good deal of alumina (8.58 per cent in one instance) and traces of lime and magnesia. This mineral and some of its varieties is still under investigation, and, on this account I reserve further details of my analyses.

*Churchite*,  $5\text{CeO}\cdot\text{CaO}\cdot 2\text{P}_2\text{O}_5\cdot 8\text{aq}$ .—The discovery of this species in 1864 was also the discovery of the occurrence of cerium in England. The mineral, which occurs in definite crystals of hardness 3, and density about 3.14, is also new to science. It is of Cornish origin, and occurs with quartz in a copper lode. The chief metallic constituent of the species, though put down as cerium, really contains lanthanum and didymium as well. The mean results of analysis are as follows:—

	Experiment.	Theory.
CeO .. ..	51.87 .. ..	52.73
CaO .. ..	5.42 .. ..	5.47
P <sub>2</sub> O <sub>5</sub> .. ..	28.48 .. ..	27.73
H <sub>2</sub> O .. ..	14.93 .. ..	14.07
	100.70	100.00

For further details see CHEM. NEWS, vol. xii., pp. 121, 183 (1865); *Journ. Chem. Soc.* (2), iii., p. 259.

*Cornwallite*,  $\text{Cu}_3\text{AsO}_4\cdot 2\text{CuH}_2\text{O}_2\cdot \text{aq}$ .—The hitherto accepted formula for this very rare cupric arseniate was founded upon two incomplete analyses. By numerous analyses of three good specimens I succeeded in proving that two-fifths of the water assumed in the formula was not really present. Since my new analyses were published I have confirmed the views there stated by fresh studies, both chemical and microscopical, of the mineral. For details see *Journ. Chem. Soc.* (2), vi., 276.

*Delvauxite*,  $\text{FePO}_4\cdot\text{FeH}_3\text{O}_3\cdot \text{aq}$ .—This formula represents the composition of delvauxite (from Liege) freed from hygroscopic water by desiccation over sulphuric acid *in vacuo*. Dried at 100° the mineral loses one atom of water, and has then the formula of dufrenite. The older analyses of delvauxite gave most discordant results as to its percentage of water.\*

*Dufrenite*,  $\text{FePO}_4\cdot\text{FeH}_3\text{O}_3$ .—Previous to some analyses of dufrenite which I made in 1864 the formula of dufrenite was unsettled, owing to the difficulty of obtaining samples for analysis free from the matrix of hæmatite, and to the obstinacy with which a portion of the constituent water is retained.†

*Hisingerite*,  $\text{Fe}_2\text{O}_3\cdot 2\text{SiO}_2\cdot 2\text{aq}$ ; or  $5\text{Fe}_2\text{O}_3\cdot 9\text{SiO}_2\cdot 8\text{aq}$ .—This species was discovered for the first time in Cornwall last year. The analytical results of previous examinations of this substance have been rather variable, partly owing to the hygroscopic water present. *In vacuo*, over sulphuric acid, the powdered mineral lost in one instance 28.65 per cent of water, and at 100° only 0.54 per cent.‡

*Limnite*,  $\text{Fe}_2\text{O}_3\cdot 3\text{H}_2\text{O}$ ; or  $\text{Fe}_2\text{H}_6\text{O}_6$ .—This species is the normal ferric hydrate, and very rarely occurs in a pure condition. A singularly clean specimen, of a stalactite form, from the Botallack Mine gave me the percentages which are compared below with those demanded by theory.

	Experiment.	Theory.
Fe <sub>2</sub> O <sub>3</sub> .. ..	73.73 .. ..	74.8
H <sub>2</sub> O .. ..	24.40 .. ..	25.2
Loss .. ..	1.87 .. ..	—
	100.00	100.0

For details see *Journ. Chem. Soc.* (2), iii., p. 214; Dana's "Mineralogy," 5th ed., p. 178.

*Melanconite*, CuO.—Some black crystals, of density 5.83, embedded in a greenish matrix were found in Cornwall; they were handed to me by Mr. Talling. They proved to be pure cupric oxide. Professor Maskelyne has determined them to belong to the oblique prismatic system.\*

*Namaqualite*,  $\text{Al}_2\text{H}_6\text{O}_6\cdot 4\text{CuH}_2\text{O}_2\cdot 4\text{aq}$ .—This mineral from Namaqualand, South Africa, belongs to the rare class of hydrous oxides in which a protoxide and sesquioxide are united. It occurs in fine blue silky crystals.†

*Pagodite*.—Without attempting to assign a formula to the particular kind of Chinese "figure-stone," which seems to me to belong to the pagodite analysed by Walmstedt and Brush (Dana, p. 455), I may add the following analytical results to those already on record in the hope that the chemistry of the various minerals often included under agalmatolite may become ultimately more definite; a greenish grey Chinese figure-stone, of hardness 2.5 and density 2.8, gave, on analysis, the following mean percentages:—

Al <sub>2</sub> O <sub>3</sub> .. ..	31.06
SiO <sub>2</sub> .. ..	62.25
H <sub>2</sub> O .. ..	4.66
Fe <sub>2</sub> O <sub>3</sub> .. ..	0.82
MgO .. ..	0.60
	99.39

*Restormelite*.—Under the names of lithomarge, agalmatolite, or steatite, a massive greenish grey mineral, found in some abundance in the iron mine of Restormel, has been from time to time described. Its density is 2.58, its hardness 2. It differs from pinite by containing 12 instead of 6 per cent of water; it differs from halloysite by the presence of 7 per cent of alkalis. It seems to me to present evidence of being derived from a felspar; but, if so, the decomposition has not been complete. I hardly like to assign the rank of a species to restormelite, but, whatever the position ultimately assigned to it, a distinct name is necessary.‡

*Tallingite*,  $\text{CuCl}_2\cdot 4\text{CuH}_2\text{O}_2\cdot 4\text{aq}$ .—This mineral, which I first detected and analysed in 1865, is ranked by some mineralogists as a sub-species or as a variety of atacamite. Besides possessing a different composition, with a different colour and other physical characters, it appears to have that definiteness and constancy of composition without which a non-crystalline mineral is regarded with suspicion.

	Experiment.	Theory.
Cu .. ..	10.11 .. ..	22.55
Cl .. ..	11.33 .. ..	
CuO .. ..	53.57 .. ..	53.29
H <sub>2</sub> O .. ..	24.99 .. ..	24.16
	100.00	100.00

Another blue hydrated cupric oxychloride from the same mine, Wheal Cock, near Botallack, Cornwall, was found to be still more basic than tallingite.||

*Tasmanite*,  $\text{C}_{40}\text{H}_{62}\text{O}_2\text{S}$ .—A fossil resinoid substance, of brown-red colour, occurring to the extent of 30 to 40 per cent in a shale from the River Mersey, Tasmania. It is supposed to have been originally the spore cases of some cryptogam; its hardness is about 2.0 and its density 1.18. The analytical percentages follow:—

\* CHEMICAL NEWS, vol. x., p. 145.

† *Ibid.*, vol. x., p. 157.

‡ *Journ. Chem. Soc.*, Jan., 1870.

\* *Vide* CHEMICAL NEWS, xi., p. 122.

† *Journ. Chem. Soc.*, January, 1870.

‡ *Ibid.*, June, 1870.

|| *Ibid.* (2), iii., p. 213.



	Experiment.	Theory.
C .. ..	79.34 .. ..	79.21
H .. ..	10.41 .. ..	10.23
O .. ..	4.93 .. ..	5.28
S .. ..	5.32 .. ..	5.28
	100.00	100.00

For further details, *Phil. Mag.* (4), xxviii., p. 465.

*Tavistockite*,  $\text{Ca}_3\text{2PO}_4\text{Al}_2\text{H}_6\text{O}_6$ .—This mineral, occurring in minute white acicular crystals with quartz, pyrites, childrenite, &c., has been found near Tavistock, and at Stenna Gwyn. It might be mistaken for pharmacolite. It gave on analysis—

	Experiment.	Theory.
CaO .. ..	36.27 .. ..	35.97
$\text{Al}_2\text{O}_3$ .. ..	22.40 .. ..	22.06
$\text{P}_2\text{O}_5$ .. ..	30.36 .. ..	30.41
$\text{H}_2\text{O}$ .. ..	12.00 .. ..	11.56
	101.03	100.00

For analyses see *Journ. Chem. Soc.* (2), iii., p. 263.

*Woodwardite*,  $3\text{CuSO}_4, 8\text{CuH}_2\text{O}_2, 3\text{Al}_2\text{H}_6\text{O}_6, 6\text{aq}$ .—This Cornish species is near Lettsomite (Cyanotrichite). It occurs in minute botryoidal concretions of a rich turquoise or greenish blue colour. In composition it is perfectly definite and constant, but Professor Maskelyne considers it to be allophane, which contains 20 per cent of silica, though the new mineral merely contains traces (about 1 per cent) of that substance. On the other hand, M. Pisani considers it impure langite, assigning as his reason for this view that another mineral occurring in the same mine, of a dirty green colour and obviously mixed character (some specimens being made up of nine\* different layers), was of indefinite constitution. It is unnecessary to combat these views.

#### ON THE

#### ACTION OF SULPHURIC ACID ON DIALLYL.†

By WILLIAM ROBERT JEKYL.

Dalton Chemical Scholar in Owen's College.

DIALLYL was first prepared by Berthelot and Luca in 1856. They found that it dissolves in concentrated sulphuric acid with the evolution of much heat, and that after some hours an oil separates, which appears to be modified hydrocarbon.

In 1866 Schorlemmer published a paper on a new series of hydrocarbons derived from coal tar, having the formula  $(\text{C}_n\text{H}_{2n-2})_2$  (*Proc. Roy. Soc.*, xv., 132). He there says, "As these hydrocarbons were obtained by the action of sulphuric acid on coal tar oils boiling below  $120^\circ$ , and as they differ by  $\text{C}_2\text{H}_4$ , it appears to me almost certain that they are polymers of the hydrocarbons of the acetylene series,  $\text{C}_n\text{H}_{2n-2}$ , formed in the same way as diamylene is formed by treating amylenes with sulphuric acid. In order to test this theory I have made some experiments with the two isomers  $\text{C}_6\text{H}_{10}$ , viz., diallyl and hexylene. By acting with sulphuric acid on these compounds, I obtained, besides large quantities of tarry matter, polymeric modifications boiling above  $200^\circ$ , having a smell similar to the hydrocarbons described above, giving also similar nitro-compounds; but the quantities which I got were not large enough for a more exact examination." With a view to throwing light upon this point, at the request of Mr. Schorlemmer I undertook to investigate the action of sulphuric acid on diallyl. The diallyl used was obtained by the action of sodium upon allyl iodide and boiled at  $59^\circ$ . Since concentrated sulphuric acid acts with great violence upon diallyl, the latter was diluted with about an equal bulk of pure paraffins boiling at from  $55^\circ$  to  $60^\circ$ . To

this mixture sulphuric acid was gradually added in small quantities, the bottle being frequently shaken. At the end of the reaction the contents of the bottle were found to be arranged in two layers, of which the upper one consisted of unaltered paraffins, and the whole of the diallyl having been taken up by the acid. The heavier and acid portion was diluted with water, when a dark coloured oil lighter than water separated out, and the whole was distilled from a large flask. The distillate consisted of a light oil, which came over below  $100^\circ$ , mixed with a little water. After a second solution in sulphuric acid and a repetition of the foregoing processes, in order to remove all traces of the paraffins, the oil was dried over calcium chloride and heated for some hours over potassium. The oil was thus obtained pure and boiled constantly at  $93^\circ$ . Analysis showed that its composition is expressed by the formula  $\text{C}_6\text{H}_{12}\text{O}$ .

This substance is readily soluble in concentrated sulphuric and fuming hydriodic acids, and slightly so in water. It is unacted upon by either caustic potash or potassium, and possesses a strong ethereal odour like that of peppermint. In presence of potassium bichromate and sulphuric acid, it yields a blue colour, similar to that produced by perchromic acid and common ether.

This compound has already been obtained by Wurtz (*Ann. Chim. Phys.*, (4), iii., 174), by treating di-iodhydrate of diallyl with silver oxide. He calls it diallyl monohydrate, but says further on that this body comports itself as an oxide or anhydride (ether), corresponding to dihydrate of diallyl,  $\text{C}_6\text{H}_{12}\text{O}_2$ , standing to the latter in the same relation as hexylene oxide to hexylene glycol, and might be called therefore *hexylene-pseudoxide*. As I have shown that the body is not acted upon by potassium, this view of Wurtz's is correct—it cannot be a hydrate, and I therefore propose to adopt Wurtz's second name, and to call it pseudoxide of hexylene.

To throw some light on its constitution it was oxidised by heating it in sealed tubes with a solution of potassium bichromate and sulphuric acid. On opening the tubes carbonic acid was evolved. Their contents were distilled, and the distillate neutralised with sodium carbonate. The neutral sodium salt was heated in a retort with sulphuric acid, by which means a distillate was obtained, which furnished a silver salt. The following analysis shows the salt to be silver acetate:—

Found.	Calculated for silver acetate.
64.41 per cent silver.	64.67 per cent silver.

The mother-liquor likewise furnished silver acetate.

Repeated experiments showed that nascent hydrogen evolved from sodium amalgam is without action upon hexylene pseudoxide.

Hydriodic acid acts upon the pseudoxide even in the cold. A few grammes of the substance were heated at  $100^\circ$  with an excess of fuming hydriodic acid in sealed tubes for about four hours. A red heavy liquid formed at the bottom of the tubes, the contents of which were distilled from a retort in presence of a little phosphorus. The iodide in the distillate was separated from the water, dried over calcium chloride, and distilled under a partial vacuum. On distillation, much decomposition ensued, with the formation of hydriodic acid, a little free iodine, and with the separation of tarry matter. After a second distillation *in vacuo*, and drying over caustic potash, a liquid was obtained, boiling under the ordinary pressure of the atmosphere, at  $165^\circ$  to  $167^\circ$ , which is the boiling-point of the  $\beta$  hexylic iodide of Wanklyn (*Chem. Soc. Journal*, 21).

Several iodine determinations, made by means of an alcoholic solution of nitrate of silver, further shows the substance to be hexyl iodide.

	Found.	Calculated for $\text{C}_6\text{H}_{13}\text{I}$ .
(1)	59.43	59.90 per cent iodine.
(2)	59.68 per cent iodine.	

In order to convert hexyl iodide derived from hexylene pseudoxide into hexyl hydride, Schorlemmer's method was

\* *Journ. Chem. Soc.* (2), iv. p. 130.

† Read before the Literary and Philosophical Society of Manchester, October 18th, 1870.



employed. The oil obtained by this means contained but little olefines, and after purification boiled constantly at  $68^{\circ}$  to  $69^{\circ}$ . The following results of analysis show that it consisted of hexyl hydride.

		Found.		Calculated for
		(a)	(b)	$C_6H_{14}$ .
C	.. ..	83.49	83.35	83.72
H	.. ..	16.30	16.42	16.28
		99.79	99.77	100.00

A portion of this hexyl iodide was oxidized by heating it in a flask attached to an upward condenser with a solution of bichromate of potash and sulphuric acid. During the operation much carbonic acid was liberated. The condensed acid was rendered neutral by sodium carbonate. From the sodium salt thus formed the acid was fractionated from a retort by adding successively five drops of sulphuric acid. From the first four distillates silver salts were obtained which furnished the following results on analysis.

		Found.	Calculated for silver acetate.
		(a)	(b)
(1)	59.36 per cent silver.	64.67	64.67
(2)	66.63 " "	64.67	64.67
(3)	64.13 " "	64.67	64.67
(4)	64.66 " "	64.67	64.67

The non-agreement of No. 1 with the calculated results was owing to the fact that the salt was very impure and uncrystalline, nor could I succeed in purifying it by re-crystallisation. From distillates No. 2 and 4 similar results were obtained from salts, which crystallised from the mother-liquors. A second series of experiments, in which a weaker oxidising solution was employed, also yielded carbonic and acetic acids as the products of oxidation. It is of interest that the hexyl iodide, which was obtained from hexylene pseudoxide, and the boiling-point of which resembled that of Wanklyn's  $\beta$  hexylic iodide, yielded carbonic and acetic acids as oxidation products, while the  $\beta$  iodide yields, on the other hand, butyric acid in addition.

The diluted sulphuric acid, which had been used for acting upon diallyl, was neutralised with barium carbonate, filtered and evaporated to dryness, but no organic sulpho-acid had been formed.

*Polymers of Diallyl.*—After distilling off the hexylene pseudoxide from the diluted acid, a layer of hydrocarbons remained on the top of the liquid, from which they were separated by means of a stop-funnel. The hydrocarbons were dried over calcium chloride, and found to boil at between  $200^{\circ}$  and  $300^{\circ}$ . After several distillations over metallic sodium, they were separated into three portions, boiling at from  $205^{\circ}$ — $215^{\circ}$ ,  $240^{\circ}$ — $245^{\circ}$ ,  $275^{\circ}$ — $285^{\circ}$ . These hydrocarbons invariably left a slight residue on distillation. Analysis showed that they have an empirical formula of  $C_6H_{10}$ .

(1) Boiling-point  $205^{\circ}$ — $215^{\circ}$ .

		Found.		Calculated for
		(a)	(b)	$C_6H_{10}$ .
C	.. ..	87.31	87.38	87.8
H	.. ..	12.52	12.31	12.2
		99.83	99.69	100.0

(2) Boiling-point  $240^{\circ}$ — $245^{\circ}$ .

		Found.		Calculated for
		(a)	(b)	$C_6H_{10}$ .
C	.. ..	87.30	87.30	87.8
H	.. ..	12.42	12.31	12.2
		99.72	99.61	100.0

(3) Boiling-point  $275^{\circ}$ — $285^{\circ}$ .

		Found.	Calculated for
		(a)	$C_6H_{10}$ .
C	.. ..	86.96	87.8
H	.. ..	12.81	12.2
		99.77	100.0

No. 3 attacked sodium slightly, although it had been distilled over it several times, therefore it is probable that its non-agreement with the calculated result was owing to admixture with an oxygen compound. From the above analysis and boiling points, it is probable that at least two polymers of diallyl are formed by the action of sulphuric acid upon it. I had not, however, a sufficient quantity of the hydrocarbons to obtain satisfactory vapour density determinations, which would at once have settled the point. It is nevertheless probable that No. 1 consists of two molecules of diallyl condensed into one, and that it has the formula  $C_{12}H_{20}$ ; for Schorlemmer, by the action of sulphuric acid on hydrocarbons boiling below  $120^{\circ}$  from cannel oil, obtained one which boiled at  $210^{\circ}$ , and the vapour density of which showed that its formula was  $C_{12}H_{20}$ .

In conclusion, I have much pleasure in tendering my thanks to Dr. Roscoe and Mr. Schorlemmer, for their kindness and attention to me throughout the whole course of this research.

# ON A SPECTROSCOPE IN WHICH THE PRISMS ARE AUTOMATICALLY ADJUSTED FOR THE MINIMUM ANGLE OF DEVIATION FOR THE PARTICULAR RAY UNDER EXAMINATION.

By JOHN BROWNING, F.R.A.S.

IN spectroscopes of ordinary construction, when several prisms are employed, a great deficiency of light will be noticed towards the more refrangible end of the spectrum.

This arises from the fact that the prisms are adjusted to the minimum angle of deviation for the most luminous rays which occupy the middle of the spectrum. The effect of this is shown in Fig. 1, P P.

In Fig. 1, P P, &c., represent a train of prisms adjusted, as I have just described, for the central portion of the spectrum, and screwed firmly in their places. T represents a telescope, moving round a centre situated at K. In the position in which the telescope is placed, the whole field of the object-glass would be filled with the green light of the spectrum issuing from the last prism; but, when the telescope is removed to the position shown by the dotted lines, either nearer to R or to V (in which case the red end or the violet end of the spectrum would be in the field of view), then, as we see by the lines, only a small portion of the spectrum would fall on the object-glass. But, it is obvious that, owing to the deficiency in light at the extreme ends of the spectrum, it is just in these very positions that it is desirable that the whole field of the object-glass should be filled. Now this can only be effected when the prisms are adjusted to the minimum angle of deviation for the particular portion which is being examined of the spectrum, and this it will be if the adjustment I have spoken of has been correctly made. This difference of adjustment is much more than is generally supposed, varying, in accordance with the refractive index of the glass employed, between  $10^{\circ}$  and  $20^{\circ}$  for the extreme portions of the spectrum.

Fig. 2 shows the method in which the change in the adjustment of the prisms to the minimum angle of deviation for each particular ray is made automatically.

In this diagram, P P, &c., as before, represent prisms. All these prisms, with the exception of the first, are unattached to the plate on which they stand, the triangular stand on which the prisms are hinged together at the angles corresponding to those at the bases of the prisms.

To each of these bases is attached a bar, B, perpendicular to the base of the prisms. As all these bars are slotted and run on a common centre, the prisms are



brought into a circle. This central pivot is attached to a dovetail piece of two or three inches in length, placed on the under-side of the main plate of the spectroscope; which is slotted to allow it to pass through. On moving the central pivot, the whole of the prisms are moved, each to a different amount in proportion to its distance in the train from the first or fixed prism on which the light from the slit falls after passing through the collimator, c. Thus, supposing the first prism of the train opposite c, represented in the diagram, to be stationary, and the second prism to have been moved through  $1^\circ$  by this arrangement, then the third prism will have moved through  $2^\circ$ , the fourth through  $3^\circ$ , the fifth through  $4^\circ$ , and the sixth through  $5^\circ$ . As these bars are at right angles to the bases of the prisms, and all of them pass through a

itself, and thereby the whole field of the object-glass is filled with light.

Thus the apparatus is so arranged that on turning the micrometer-screw, so as to make a line in the spectrum coincide with the cross wires in the eye-piece of the telescope, the lever, L, attached to the telescope and prisms, sets the whole of the prisms in motion, and adjusts them to the minimum angle of deviation for that portion of the spectrum.

Figs. 3 and 4 represent the appearances presented when looking through the telescope from which the glasses have been removed; in diagram 3 it will be seen that the whole circle of the object-glass is filled with light, as I have just described is the case with the new arrangement; while diagram 4 shows the effect of moving

FIG. 1.

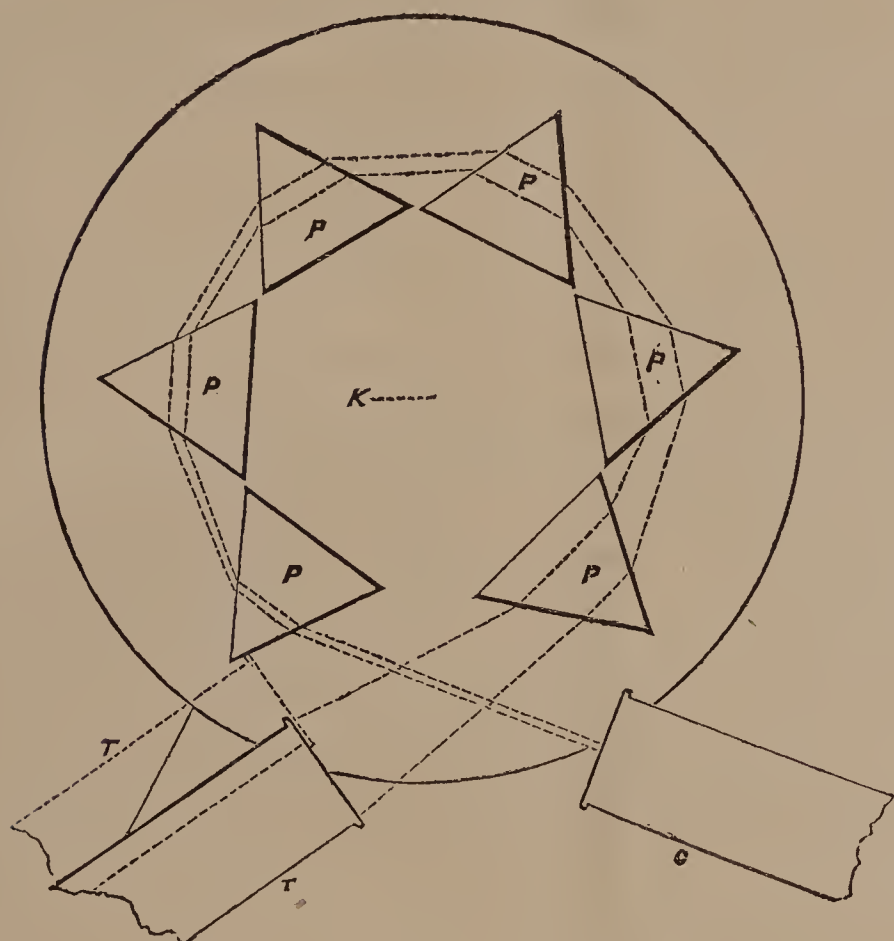


FIG. 2.

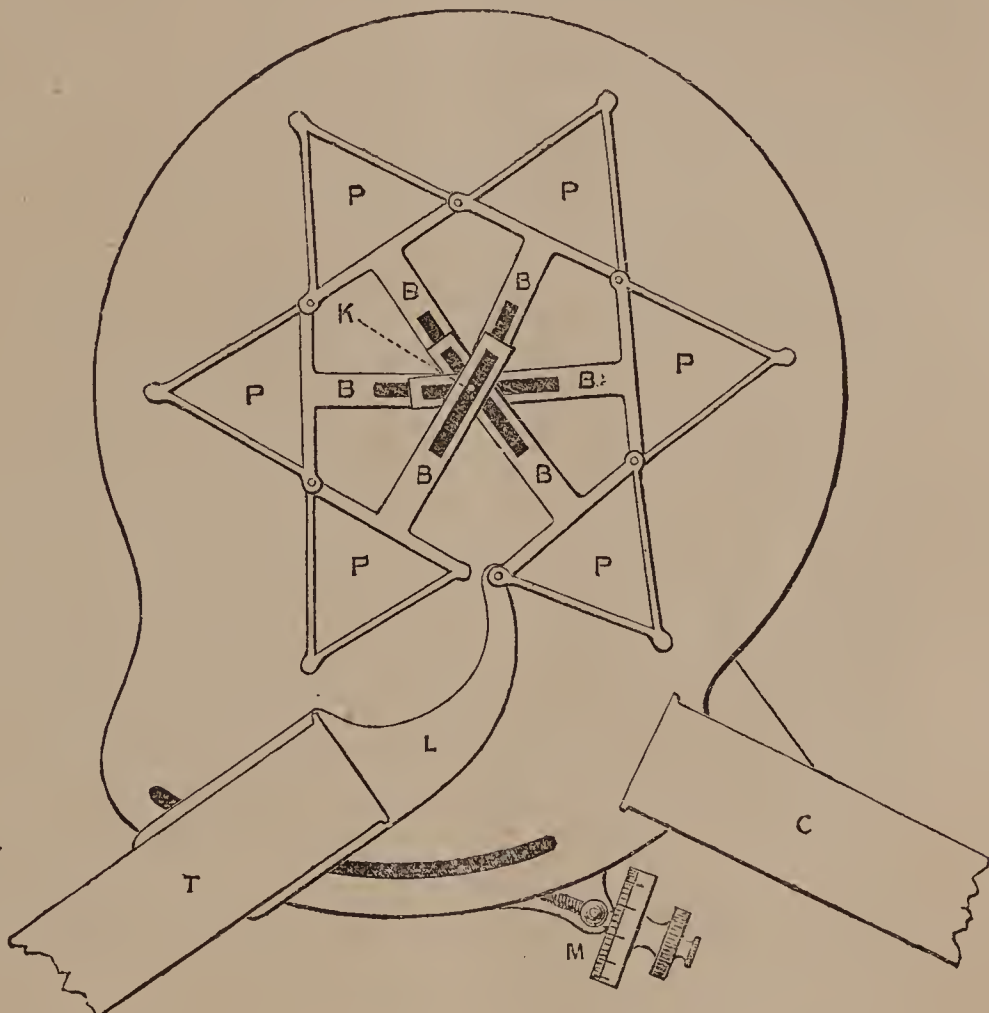


FIG. 3.



FIG. 4.

common centre, it is evident that the bases of the prisms are at all times tangents to a common circle.

Now for the contrivance by which this arrangement is made automatic. A lever, L, is attached to the corner of the triangular plate of the last prism. This lever by its further end is attached to the support which carries the telescope through which the spectrum is observed.

Both the telescope and lever are driven by the micrometer screw, M. The action of the lever is so adjusted that when the telescope is moved through any angle it causes the last prism to turn through double that angle.

The rays which issue from the centre of the last prism are thus made to fall perpendicularly upon the centre of the object-glass of the telescope, T, and thus the ray of light travels parallel to the basis of the several prisms, and ultimately along the optical axis of the telescope

the telescope through the angle in front of the fixed prism.

About three years ago I showed a rough model of the plan I have now described to Mr. Gassiot, for whom I made the large spectroscope which was for some time in use at Kew Observatory.

Mr. Gassiot immediately asked me if I would apply this arrangement to his large spectroscope. As I did not at that time see my way to make it self-acting by connecting the prisms with the micrometer-screw, I did not feel impelled to carry out the matter at once, owing to the fact that, about this time, the mapping of the solar spectrum, with the large spectroscope in question, was discontinued. I also felt that, with the munificent liberality for which Mr. Gassiot has distinguished himself, he had simply asked me to add this contrivance to his large and costly



instrument in the interest of science generally, and not with any view to its immediate use.

Since this time, and particularly while I was constructing his solar spectroscope, Mr. Norman Lockyer has repeatedly urged upon me the desirability of completing the arrangement, and from the manner in which it has been received by the distinguished scientific men who have done me the honour to examine it minutely, I am induced to hope that its application will tend to facilitate further researches in spectrum analysis.

The instrument I have had the honour to describe possesses some special advantages for chemical investigations. Professor Roscoe no sooner saw it than he suggested that I should observe the ultra-violet rays of aluminium with it. These it showed to great perfection.

It may well be that careful researches made by its aid on spectra of various bodies might lead to the detection of elements as yet unknown.

## SODIUM AS A FLUX FOR MINERALS.

By Dr. SCHONN.

A STEEL crucible  $1\frac{1}{4}$  inches deep and the same in diameter is heated over a lamp; into this is projected a few pieces of metallic sodium, and afterwards the finely-divided and dry mineral is added. The crucible is then covered and heated red-hot. As soon as the reaction is finished the contents of the crucible are allowed to cool, and water is cautiously added, sufficient for the purpose of filtration. The fused mass is then thrown upon a filter and thoroughly washed. In the filtrate will be found the electro-negative constituents of the mineral combined with the sodium, such as sulphur, cyanogen, chlorine, chromic acid, silica, molybdic and tungstic acids, and such oxides as are soluble in soda-lye. On the filter will be found the metals and their oxides, also the lower oxides of titanium, molybdenum, tungsten, and possibly silica and alumina. The contents of the filter and the solution in the filtrate can be further treated according to the order of analysis. In this way all minerals can be readily resolved, and their constituents determined either qualitatively or quantitatively.

## CORRESPONDENCE.

### NEW ELECTRO-DYNAMIC LAW.

To the Editor of the Chemical News.

SIR,—Will you allow me to announce in your journal a new and important electro-dynamic law or laws. The reasonings and experiments, by which they are supported, I hope to enter on more fully in the next number of the *Quarterly Journal of Science*. Meanwhile, I submit them to the judgment of physicists for examination and approval, or otherwise.

1. In every galvanic circuit, the net heat produced by the chemical decomposition is divided into three parts—(a) due to merely local action arising from the impurities in the positive metal, or the re-formation of water from the nascent hydrogen; or (b) that which circulates through the battery and all other parts of the circuit, and which varies as the electro-motive power of the negative element in relation to the electro-positive; and (c) the residue which remains in the battery.

2. That part which circulates through the whole circuit is distributed in each part of the circuit, including the battery, in simple proportion to the resistance of each part.

These laws are thus expressed mathematically:—

Let  $H$  = total net heat produced;  
 $H_1$  = heat produced by waste local action on the positive metal;  
 $H_2$  = the quantity put into circulation;  
 $H_3$  = the residue not put into circulation.  
 Then, of course—

$$H = H_1 + H_2 + H_3;$$

$$\text{and } \frac{H_2}{H_2 + H_3} = E,$$

$E$  being the electro-motive force of the negative element in relation to the positive element used.

Also, if  $H(b)$  be the total heat evolved in the battery when the circuit is closed;

$$h(b) = H(1) + H(3) + H(2) \frac{R}{R + r}$$

$$h(w) = H_2 \frac{r}{R + r}$$

and if  $r(1), r(2), r(3)$ , be the resistance of different parts of the circuit;

and  $h(1), h(2), h(3)$ , the heat evolved in those parts;

$$h(1) = H_2 \frac{r(1)}{R + r}$$

$$h(2) = H_2 \frac{r(2)}{R + r}$$

and so on.

$$\text{Again, if } H(3) = 0 \text{ or } \frac{H_2}{H(2) + H(3)} = 1$$

then the electro-motive power of the negative element is perfect as relates to the electro-positive element.

In a circuit of zinc in sulphate of zinc, and copper in sulphate of copper,  $E = 1$ , or the whole heat produced, is transmitted; with zinc, strong sulphuric acid, and platinum,  $E = \text{about } \frac{5}{6}$ , but varies with the strength of the acid; with iron in sulphate of iron, and copper in sulphate of copper,  $E = \text{about } \frac{2}{3}$ ; with copper in nitrate of copper, and silver in nitrate of silver,  $E = \text{about } \frac{3}{4}$ .

The total electro-motive force of a couple depends partly on the net heat evolved, partly on the proportion of it transmitted through the circuit. The former depends principally on the positive element, the latter on the negative element.—I am, &c.,

H. HIGHTON, M.A.

2, The Cedars, Putney,  
November 1, 1870.

### MR. CHURCH'S PROCESS OF PRESERVING STONE.

To the Editor of the Chemical News.

SIR,—In your journal of last week I find the text of a paper, by Mr. A. H. Church, which was read at the Liverpool meeting of the British Association. Mention is made therein of a complex system of treating stone, which has been patented as a new invention, and recently applied upon certain portions of the Houses of Parliament. The method consists in washing the stone surfaces with three solutions successively applied: (1st) superphosphate of lime, now called "mono-calcic phosphate;" (2nd) baryta, or "barium hydrate;" (3rd) dialysed solution of silica.

It is my purpose now to show that this so-called new process is but a modification of that applied by myself on the Houses of Parliament in April, 1864, with points added, which may have been derived from other previously published sources. The *dialysed silica solution* is that of which the preparation and specific employment for these purposes was first described by yourself in November, 1861. (CHEMICAL NEWS, vol. iv., p. 227.) And, the *superphosphate of lime*, mixed with a little *baryta* for the purpose of decomposing the sulphates in the stone, was the solution actually employed by myself in the competitive trial at Westminster. Your readers are, therefore,



in a position to judge for themselves of the novelty of Mr. Church's improved process, which, by some unaccountable aberration, stands now patented in the name of Frederick Ransome.

I have only to add that I felt it my duty to address a letter upon the subject to the First Commissioner of Her Majesty's Works, protesting against this practical adoption of my process by a fellow competitor, immediately it became known to me that a trial of Mr. Church's triple plan had been sanctioned.—I am, &c.,

JOHN SPILLER.

London, Nov. 1st, 1870.

## MISCELLANEOUS.

**Spectrum of the Aurora.**—We hear from Professor A. H. Church, of the Royal Agricultural College, that he was able to observe the spectrum of the aurora as seen at Cirencester on the 24th and 25th ult. He saw a steady yellowish green line, and frequently a brilliant red line near that of calcium. A pale line was also seen in the green, and a more definite one in the blue—these last not being constant in occurrence. The observations were made each evening between 6.30 and 8.30 p.m.

**Apparatus for Maintaining Constant Temperatures in Laboratory Operations.**—Messrs. Mottershead and Co. have just brought out an improved automatic regulator which is applicable to any operation in which gas is used as a source of heat. When fitted to copper drying closets or air baths the temperature may be limited to any degree from 75 F. upwards. This apparatus acting automatically, the temperature is unaffected by varying pressure of gas, the common source of accident in ordinary drying closets. Drying closets and evaporating basins are also fitted on a slightly modified plan, in which a reservoir of air placed *inside* the oven is made to act on the regulator, thus avoiding the necessity of a double copper chamber, and at the same time forming a sufficiently sensitive apparatus for many practical purposes.

**The Photographic Exhibition.**—The members of the Photographic Society will assemble at the Architectural Gallery, No. 9, Conduit Street, on Tuesday evening next, for the purpose of inaugurating their new session by the holding of the Fifteenth Annual Exhibition of Photographs. On the following day the galleries will be thrown open to the public, and continue so daily from 9 a.m. till dusk (Saturdays excepted) until the end of the month. The members have reserved to themselves and friends the right of free admission during the three Saturdays falling within this period, but the general public will, even on these days, be admitted on the usual terms of payment. In addition to the more ordinary productions of photography there will be exhibited examples of work done by the photo-mechanical printing processes of Herr Albert, MM. Ohm and Grossman, Mr. Woodbury, and others; besides a collection of photo-enamels, micro-photographs, reproductions, and enlargements.

**Alloy known as "Tiers Argent."**—Dr. C. Winkler.—The author says this alloy does not consist of  $\frac{1}{3}$  of silver and  $\frac{2}{3}$  of nickel, but was found, when analysed by him, to be made up of copper 59.06; silver, 27.56; zinc, 9.57; nickel, 3.42; total, 99.61.

**Condensation of the Nitrous Vapours in the Manufacture of Sulphuric Acid.**—R. Heilmann and P. Hart.—The vapours are condensed by means of water, wherein lime or magnesia are suspended, and the liquid thus obtained is either (a) first evaporated to dryness, and the residue ignited; or (b) heated to the boiling point, with addition of hydrochloric or sulphuric acid; or (c) evaporated to dryness, and the residue mixed with the residues of the manufacture of chlorine, and heated to a gentle red heat; in either of these three cases the nitrous vapours are again utilised in the leaden chambers.

**Indelible Black Ink.**—H. Puscher.—Dissolve 1 drachm of aniline black in 5 drachms of strong alcohol, to which add some 60 drops of pure and strong hydrochloric acid; next add a hot solution of  $1\frac{1}{2}$  drachms of powdered gum arabic in 3 fluid ounces of water. Writing made with this ink is indelible by chlorine, oxalic, nitric and hydrochloric acids, and caustic potassa.

**Prevention of the Spontaneous Combustion of Coals.**—Dr. A. Lachmann.—In order to prevent as much as possible the chances of spontaneous combustion of coal on board ships and in the coalbunkers of steam-vessels, the author advises: to select coal as much as possible free from brasses (iron pyrites); to load the coal rapidly, and in as dry a state as possible; to stow them on board properly, but not too closely; to prevent, as much as possible, all access of air and water, and to sprinkle them with thin coal tar.

**Induline, a new Blue Dye Material.**—R. Knosp.—The author states, unfortunately, nothing about the nature, nor anything about the manufacture, of what he calls induline. He says it is a new pigment which is readily soluble in water yielding therewith a reddish blue coloured solution, which can be at once applied for dyeing purposes; best, however, after the addition of some sulphuric acid, and at boiling heat. The author further states that induline will certainly become an excellent substitute for indigo vats, and be especially of value for the dyeing of wool.

**Manufacture of Iodine from the so-called Chili Saltpetre (Nitrate of Soda).**—Dr. A. Lachmann.—The author states that at Tarapaca, Peru, there are now obtained about 40 kilos. of iodine daily by means of a process which is described as follows:—The mother-liquors from the refining of the crude nitrate of soda are carefully mixed with a mixture of sulphurous acid and bisulphite of soda, whereby all the iodine present in the liquor is precipitated in the free state as a blackish coloured precipitate; the iodine thus deposited is next freed from adhering fluid by placing it in an earthenware vessel, at the bottom of which are placed several layers of clean sand, so arranged that the size of its grains decrease from the bottom upwards. On the top of this sand the wet iodine is put, the sand acting as a sponge to absorb the fluid. When the iodine has become dry, it is carefully removed from the vessel, but a thin layer of it is left on the sand; the crude iodine is refined by sublimation. The inventor of this process, a Frenchman named Thiercelin, has recently found that, instead of using sulphurous acid, it is more advantageous to employ nitrous acid, obtained in the shape of nitrite of potassa by the ignition of a mixture of 1 part of charcoal and 5 of nitrate of potassa; the nitrite obtained yields, when mixed with the mother-liquor, a precipitate containing some 80 per cent of iodine.

**Fusing Iridosmine.**—Mr. Moses G. Farmer, of Boston, has fused the native iridosmine by placing the natural grains in a groove in charcoal, and subjecting them to the action of a current of voltaic electricity from sixty large Bunsen cells, using large platinum wires to make contact with the ends of the groove. He obtained in this manner bars of perfectly compact metal, brittle and very hard. The operation was anything but pleasant, on account of the intense light emitted and the fumes of osmic acid, which attacked the eyes and nostrils, producing the phenomena of rose or hay fever, and sunburning the face. Mr. Farmer estimates the temperature of the fusion at about 10,000° F. The object of the experiment was to prepare a bar of the alloy for the purpose of electric illumination. On rendering it luminous by an electric current, he found that when near the melting-point one square inch of surface evolved light equal to 2800 candles, which threw shadows in broad daylight at noon, and produced excellent photographs. The same battery converted solid bichloride of iridium into fused metal as soft and ductile as platinum. An aluminium wire, conveying a current



which raised it to near its fusing point, became perfectly flexible, like a hempen cord, being fused within, but preserving its continuity by its crust of oxide. A steel point thrust into it drew out the fused metal in threads.—*American Chemist.*

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

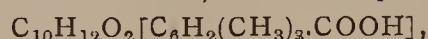
*Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

*Zeitschrift für Chemie von Beilstein, No. 15, 1870.*

The original papers and memoirs contained in this number are—

**Products of the Oxidation of Durol.**—P. Jannasch.—This paper is the first part of a series on this subject, the portion before us treating on cumylic acid. When durol is acted upon by nitric acid diluted with  $2\frac{1}{2}$  times its bulk of water, the result is the production of a third homologue of benzoic acid, an acid composed of—



which has been named by this author *cumylic acid*. It is insoluble in water, but readily soluble in ether and alcohol; soluble also, but with more difficulty, in benzol; crystallises in prismatic crystals; volatilises along with aqueous vapours; sublimable; fusing at  $150^\circ$ . The author briefly describes the lime- and baryta-salts of this monobasic acid.

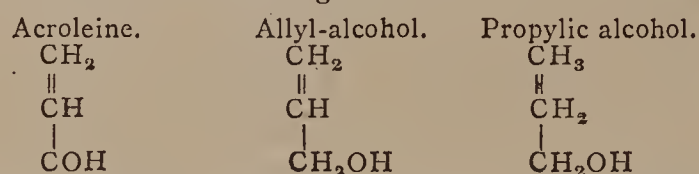
**Bromo-Sulpho-Toluol.**—H. Hübner and F. C. G. Müller.—This lengthy paper contains the description of a series of salts obtained by operating with a large quantity of crude bromo-toluol-sulphate of calcium, after having been purified. The formula of this salt was ascertained, by analysis, to be  $(C_6H_3Br.CH_3.SO_2.O)_2Ca$ . It is an anhydrous salt, which admits of being heated to  $230^\circ$  without decomposition; it is soluble in 60 parts of water at  $14^\circ$ . From a concentrated solution the salt crystallises in large brilliantly-shining crystals. The lead, barium, strontium, copper, zinc, manganese, and sodium salts, obtained by double decomposition, are described at great length. The bromotoluol-sulpho acid, in free state, is a deliquescent substance. The sulphochloride, prepared from the above-named sodium-salt by means of chloride of phosphorus, constitutes a solid compound, fusing at between  $25^\circ$  to  $53^\circ$ , insoluble in water, very soluble in ether, and remarkably resisting decomposition. In perfectly pure state, it is possible to heat this substance to  $200^\circ$  without decomposition; but, at a higher temperature, sulphurous acid is given off, and at  $260^\circ$  the decomposition becomes tumultuous. The authors also prepared the sulphhydrate and the bisulphide of bromo-sulpho-toluol. The bisulphide is insoluble in water, fuses at between  $75^\circ$  and  $78^\circ$ , and is difficultly soluble in alcohol.

**Presence of Cholesterine in Suint.**—E. Schulze.—By the term suint is understood that peculiar kind of grease which is naturally present in sheep's wool. This raw material the author extracted from raw wool taken from sheep at a farmyard near Weende, a locality in the neighbourhood of Göttingen, Prussia, Regierungsbezirk, Hanover, where is established an agricultural experimental station, to which is attached a chemical laboratory. The author operated upon 120 grms. of the raw suint, which was saponified, by which operation it was ascertained, as has also been stated by Dr. Hartmann, that suint does not contain any glycerides. A large portion of the suint (70 per cent) could not be saponified by the usual process (boiling with an aqueous solution of caustic potassa), and was therefore exhausted from the soap by means of ether. After volatilisation of that fluid, the remaining fatty substance was treated, for a period of twenty hours, with an alcoholic solution of potassa in a closed vessel at  $100^\circ$ . After a series of operations (the aim thereof being to purify the complex fatty compound), the author obtained a crystalline mass, which was recognised as cholesterine by the following reactions:—A small portion, having been rubbed up in a mortar with a few drops of concentrated sulphuric acid, yielded, after addition thereto of chloroform, a blood-red coloured liquid, which, after the addition of concentrated nitric acid, became first violet, next blue, and finally colourless. A small portion of the crystals was mixed, by the aid of a glass rod, with a liquid consisting of 3 parts, by bulk, of hydrochloric acid, and 1 part, by bulk, of solution of chloride of iron, and this mixture very gently evaporated to dryness; the undissolved mass assumed a violet-red hue, which soon turns to blue. A trace of the crystals was moistened with a drop of concentrated nitric acid, and gently evaporated to dryness; the remaining yellow speck, having been moistened with ammonia, assumed a red colouration. The anhydrous crystalline mass was found to fuse at  $144.5^\circ$  (dry and pure cholesterine fuses, according to MM. Strecker and Hoppe-Seyler, at  $145^\circ$ ). The results of the elementary organic analysis of this substance led to numbers which agree closely with

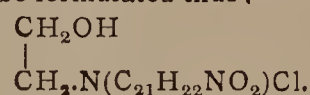
those of pure cholesterine, the formula of which is  $(C_{26}H_{44}O)$ . The author states that the cholesterine in suint is mixed with substances on which he is engaged in further researches.

**Chlorides of Sulphur.**—H. Hübner and A. Gueront.—The authors first briefly allude to the well-known compound  $S_2Cl_2$  which boils at  $136.5^\circ$ , and consists of 47.41 per cent S and 52.6 per cent Cl. This chloride is capable of absorbing more chlorine, and forms a new compound, about which various views have been stated by several distinguished scientific chemists, in reference to its true constitution. The authors have therefore made the following experiments, with the view to reconciling the existing differences of opinion:—About 80 grms. of perfectly pure  $S_2Cl_2$  were placed in a glass vessel, surrounded by a powerful freezing mixture, and saturated with perfectly dry chlorine; the excess of the latter was driven off by perfectly dry carbonic acid, previously saturated with the chloride of sulphur,  $(S_2Cl_2)$ . The newly-formed chloride, while remaining in the vessel surrounded by the freezing mixture, was sucked up in a previously accurately-weighed glass tube, which was sealed immediately afterwards, and again weighed. This having been done, the tube was carefully unsealed, and the contents immediately oxidised by means of pure and very strong nitric acid. The quantitative estimation of the chlorine and sulphur led to the following percentual results:—Sulphur, 31.07; chlorine, 68.93. The results of the researches on this subject may be summarised as follows:—There exist two definite compounds of chlorine and sulphur. One of these is a non-volatile chloride,  $Cl_2S$ , which, on being boiled, becomes decomposed in this manner:— $2Cl_2S = S_2Cl_2 + Cl_2$ . The equivalent of  $Cl_2S$  is, the authors state, not determinable, on account of the non-volatility of this body; but they take that equivalent as equal to 103. The second chloride of sulphur,  $S_2Cl_2$ , is readily formed from the other compound just alluded to, as elucidated by the formula above mentioned. The authors add that the results of their researches agree with and confirm those of M. Dumas on this subject.

**Conversion of Allyl-Alcohol into Normal Propylic Alcohol.**—B. Tollens.—This very closely-written paper contains chiefly the record of the fact, discovered recently by the author, that, when allyl-alcohol is treated with hydrate of potassa, there is obtained a considerable quantity of normal propylic alcohol, not mixed with isopropylic alcohol, when equal parts, by weight, of the two substances (viz., caustic potassa and allyl-alcohol) are operated upon. The author enters at length into the detailed description of a series of fractional distillation experiments and the substances thereby obtained, and concludes his memoir with the statement that his researches on this subject confirm the correctness of the following formulæ:—



**Strychnine Oxethyl Compounds.**—Drs. Strecker and Messel.—By heating, in a sealed tube, a mixture of one-fourth part, by weight, of epichlorhydrine, with strychnine, to a temperature of from  $120^\circ$  to  $160^\circ$ , the authors obtained strychnin-oxethyl-chloride,  $C_{23}H_{27}N_2O_3Cl$ , a body readily soluble in water, and crystallising from its solution in that liquid. The aqueous solution is not precipitated by ammonia; by a mixture of sulphuric acid and bichromate of potassa, the aqueous solution is temporarily coloured brilliantly violet. Chloride of platinum causes the precipitation of a magnificent orange-coloured double salt,  $C_{23}H_{27}N_2O_3Cl + PtCl_2$ . The authors briefly describe, further, a strychnin-oxethyl-sulphate and a strychnin-oxethyl-hydrate, and state that strychnine behaves in a manner analogous to trimethylamine, while they conclude that the constitution of this new base is analogous to choline, and should be formulated thus:—



**Sulpho-Maleinic Acid.**—Drs. Strecker and Messel.—Maleinic acid, having been boiled with an aqueous solution of neutral sulphate of potassa, yields a new body, sulpho-maleinic acid, which, however, is only cursorily alluded to in this paper as to its properties in free state, there being only mentioned a series of salts, the neutral potassa salt being represented by  $C_4H_2K_3SO_7 + H_2O$ . The free acid was obtained by the decomposition of the silver-salt by means of sulphuretted hydrogen; it is a difficultly crystallisable solid body, which, on being heated with caustic potassa, yielded fumaric acid. The main conclusion the authors draw from their researches is the absolute identity of sulpho-fumaric, sulpho-maleinic, and sulpho-succinic acids.

**Action of Ammonia upon Chloride of Thionyl and Chloride of Selenium.**—Dr. A. Michaelis.—This very lengthy essay contains the exhaustive account of a series of researches instituted by the author with the view to test the correctness of the labours instituted on this subject by Dr. Schiff (*Ann. Ch. Pharm.*, vol. cii., p. 113, and vol. cxi., 93). The first portion of this paper treats on the action of ammonia upon thionyl-chloride; and the memoir, too lengthy for any useful abstraction, contains, further, the following sections:—Action of ammonia on selenyl-chloride; action of chloride of phosphorus upon selenious anhydride and upon selenyl-chloride.

**Lime and Mortar.**—W. Wolters.—The author has experimented to obtain accurate information on the process of the hardening of lime and mortar, as applied for ordinary building purposes. The main results of these researches are the following:—The freshly applied mortar gives off, at first, water only, by which process the particles of lime begin to adhere together; afterwards, carbonic acid begins to be absorbed, and thereby the solidity of the mass is increased. The last stage of the drying of the mortar coincides with that of the saturation of the lime with carbonic acid; and this process causes the fixation of



the porous bricks with the mortar. The absorption of carbonic acid alone, without previous dehydration, never causes ordinary mortar to become hard. Freshly made mortar, exposed to an atmosphere of moist carbonic acid, remains soft; while mortar placed under a bell-jar filled with carbonic acid, and standing over a basin filled with strong sulphuric acid, becomes rapidly hard. Large quantities of mortar, especially with a limited exposure to air, take months, or even years, to become hard.

**Estimation of Phosphoric Acid in Phosphorites.**—K. Birnbaum and C. Chojnacki.—The authors state that they apply, for the above-named purpose, a modification of Dr. G. Chancel's method, which admits of being carried out in about six hours, and gives good results. The analysis is performed as follows:—Take 2 grms. of the very finely pulverised mineral; put the weighed mineral into a flask, or beaker-glass, and pour over it about 7 c.c. of nitric acid free from any chlorine, and of 1.25 sp. gr. Heat the vessel and its contents for about half an hour nearly to the boiling-point, dilute with pure distilled water, and filter; add, to the well-washed filtrate, as much water as will suffice to make up a quantity of 500 c.c. Take 100 c.c. of this liquid, representing 0.4 gm. of phosphorite; add another 100 c.c. of pure distilled water, heat to the boiling-point, and precipitate the hot fluid by the addition of a solution of nitrate of bismuth (prepared in the following manner:—Take crystallised nitrate of bismuth, dissolve in water; add as much nitric acid as is required to prevent precipitation on the addition of more water; make up the solution in such a manner as to obtain a litre of fluid containing 26 grms. of bismuth). The precipitate, occasioned by the addition of the bismuth solution to the solution of phosphorite, is left standing till quite cold, and is then filtered off, the precipitate being washed with cold water. Next, the phosphate of bismuth is dissolved, while on the filter, in a few drops of hydrochloric acid, and that solution is treated with ammonia and sulphide of ammonium, and gently heated, until all the bismuth has been converted into sulphide. When this has been effected, the liquid is acidified with acetic acid, and next heated to near the boiling-point; the precipitate is then collected on a filter, the last traces of sulphuretted hydrogen being eliminated by a few drops of chlorine-water. The phosphoric acid is estimated in the acetic acid solution by the well-known uranium process.

**Different Methods of the Estimation of Manganese.**—E. Escher and G. Rumpf.—The authors have tried comparatively, by means of a series of experiments, the following methods of the estimation of manganese:—Method of Fresenius and Will; method by which the manganese is placed in an hydrochloric acid solution of protochloride of iron, the quantity of non-oxidised iron being estimated; the method whereby, by the aid of hydrochloric acid, chlorine is developed from the manganese, and that gas taken up by hydrate of lime, followed by the estimation of the quantity of hypochlorite of lime thus produced; lastly, Bunsen's method, consisting in the evolution of chlorine from the manganese, and the passing of that gas into a solution of iodide of potassium, and estimation of the quantity of iodine set free. The authors found that only the methods of Fresenius and Will, and that of Bunsen, yield reliable results. They employed, for trial, the samples taken from one and the same large parcel of manganese, and state that the largest difference of the results obtained by applying the various methods several times were as follows:—

	Average.	Greatest difference
	per cent.	between experimental results.
		per cent.
Fresenius and Will .. ..	63.50	0.04
With protochloride of iron ..	62.06	1.15
As hypochlorite of lime ..	60.90	5.24
Bunsen's method .. ..	62.74	0.03

**Analysis of Substances which on being Heated with Hydrochloric Acid yield Chlorine.**—Dr. R. Fresenius.—In order to prevent the running back of the solution of iodide of potassium in the performance of Bunsen's titration method, the author proposes to prevent this by the addition of a few lumps of magnesite (compact native carbonate of magnesia) in the flask, the effect being the slow but steady evolution of carbonic acid gas, which, by the pressure it exerts, prevents the running back of the iodide of potassium solution.

**Preparation of Pure Hydrochloric Acid.**—Dr. R. Fresenius.—By means of direct experiments, the author has found that the method proposed by P. W. Hofmann for the preparation of pure hydrochloric acid (this method is not described, but it would appear to be based upon the driving off of hydrochloric acid gas from the crude acid as obtained in alkali works by the aid of heating with sulphuric acid, and the condensation of the gas thus set free in pure water), does not yield hydrochloric acid free from arsenic or free chlorine in case the crude acids, sulphuric and hydrochloric, employed, contain arsenic or the last named free chlorine.

**Estimation of Phosphoric Acid as Ammonio-Magnesium Phosphate.**—W. Heintz.—The main point of interest in this paper is, that the precipitate of ammonio-phosphate of magnesium, obtained in the generally known method of the estimation of phosphoric acid has to be re-dissolved in dilute hydrochloric acid after having been washed with dilute ammonia in order to get rid of a portion of the magnesia, which, in the first precipitate, is carried down, but not combined with phosphoric acid.

**Estimation of Nitric Acid in Potable Water.**—Dr. F. Goppelsröder.—The author states that having an opportunity to test Dr. Marx's plan of the estimation of nitric acid in water by means of an acid solution of indigo, he discovered that this plan yields too low results, while, moreover, the nitrites present in water are found to interfere with this process. This difficulty the author overcomes by making use of a titrated solution of permanganate of potassa applied to the water after the addition of a few drops of dilute sulphuric acid.

**Preliminary Notice.**—H. Hübner and C. Müller.—The authors state that they are engaged in experimenting upon the action of sodium upon epichlorhydrine; several new compounds are thereby formed, among which are the alcohols,  $C_6H_{12}O_2$  and  $C_6H_{14}O_2$ ; the authors give this brief notice because at present they are prevented from proceeding with these researches.

*Annalen der Chemie und Physik, von Poggendorff, No. 8, 1870.*

This number contains the following original papers and essays:—

**Thermo-Chemical Researches.**—J. Thomsen.—This paper is the continuation of the author's very lengthy essay on this subject, this present portion being divided into the following sections:—Researches on formic, acetic, oxalic, succinic, tartaric, and citric acids; researches on chromic, carbonic, and hydro-sulphuric acid; results of experiments relating to the neutralisation and basicity of the acids.

**Researches on Electric Discharges.**—W. v. Bezold.—This paper is illustrated with engravings absolutely required for the proper understanding of its contents; the results arrived at by the author's experiments may be summarised as follows:—When there are open to an electric discharge, after the breaking of an electric spark, two ways towards earth, one of which is longer than the other, the longer way being interrupted by a test-plate (Probeplatte), the result will be the division of the discharging current, if the distance the electricity passes before striking be small, but if that distance be large the electricity takes the shortest way, and carries even along with it the same kind of electricity from the longer way; if an electric current is conducted on to a wire insulated at its end, the electricity is reflected at that end, and there ensue a series of phenomena of alternating discharges; an electric discharge is carried through wires of the same length with the same velocity, irrespective of the material these wires are made of.

**Electro-Motive Force of the Electric Light.**—W. v. Bezold.—An algebraico-physical paper.

**Caloric Capacity of Water when near its greatest Density.**—L. Pfundler and H. Platter.—This memoir contains essentially a lengthy series of results of experiments exhibited in a number of tables containing several columns of figures.

**Acoustical Studies on Flames.**—E. Villari.—A lengthy essay illustrated by a series of engravings.

**Relation Existing between Transverse Contraction and Longitudinal Dilatation.**—A mathematico-physical paper.

**Compensation of an Optical Change of Phase.**—J. L. Sirks.

**Reply to M. Most.**—L. Boltzmann.—An algebraical paper, an observation also referring to the following.

**Contribution to the Molecular Theory, and to the Doctrine of Electricity.**—L. Lorenz.

**Theory of Poisson Relating to the Temperature of the Globe.**—O. Frölich.—A discussion on the value of certain algebraical formulæ put forward by M. Poisson to explain the phenomena of the disposition of the temperature over our globe.

**Curious Effects Produced by Lightning.**—Dr. J. G. Fischer.—The author describes at great length the effects caused by the lightning striking his house, a detached residence situated at a distance from Hamburg, on the 17th June last; the lightning first struck and demolished a stack of chimneys, and next found its way to the soil along a zinc pipe for conveying the rain-water from the roof downwards; the pipe alluded to, previously sound, was perforated in three places in a very curious manner; at one of the holes the metal was forced outward, while at the two other holes the metal had been forced inward in such a manner as to close the tube for the passage of water, at the point where the tube reached at the bottom the earthenware drain-pipe; the latter was smashed, the soil which covered it having been scooped out; no fire ensued by the striking of the lightning, nor was fusion of metal anywhere perceptible. The author enters into lengthy details on the magnetic action of the lightning upon steel and iron objects; none of the parties present in the house at the time of the occurrence were at all injured.

**Relation of the Specific Heat of the Air when under a Constant Pressure and Volume.**—Dr. Witte.—A short letter to the editor correcting some algebraical formulæ formerly published.

**Minimum of Prismatic Aberration.**—A. Kurz.

**Preparation of a Fluid suitable for the Formation of Plateau's Equilibrium Figures without Gravity.**—R. Büttger.—Take previously flaked palm-oil soap, place it in a large flask, and pour over it cold distilled water so as to prepare a cold saturated solution of soap, which should be filtered through grey filtering paper; there is next added about one-third part of the bulk of the fluid of pure concentrated glycerine; before using this fluid it should be well shaken up; the author states that soap bubbles of more than a foot diameter can be made with this fluid, and that such bubbles may be obtained attached to a piece of iron wire; if protected from currents of air the bubbles will persist for even ten hours.

*Pharmaceutische Zeitschrift für Russland, No. 10, 1870.*

This number contains the following original papers:—

**Various Methods of Testing the Value of Opium, and more especially on the method prescribed for that purpose in the New Pharmacopœia of the Austro-Hungarian Monarchy.**—A. Siersch.—This lengthy paper contains a review of the comparative value of the various methods proposed at different periods, and by different authors, for the estimation of the value of opium, as compared with



the method directed to be applied for this purpose by the pharmacopœia above mentioned.

**Chemical Researches on the Fruits of the Laurel Plant.**—Dr A. Casselmann.—We have already noticed this essay from another periodical. The essay itself is a separate work written in Russian.

## NOTES AND QUERIES.

Love's "Dyer and Scourer."—Can any of your readers tell me where I can get the above work?—X. Y. Z.

**Estimating Tartaric and Citric Acids.**—Can you refer me to any work giving any recognised method of estimating tartaric and citric acids in the crude substances—argol, &c.?—A. J. M. EDGER.

**Salaries.**—"Student X." will feel greatly obliged if any reader of the CHEMICAL NEWS will give him some idea of the salary a B.Sc. Lond. Univ. might reasonably expect to receive for his services in an average laboratory, London or provincial.

**Ethers in Wine.**—(Reply to "H. T. B.")—The paper you refer to—viz., "Sur la Proportion des Ethers dans les Vins et sur quelques uns des Changements qui s'y Produisent," by M. Berthelot, is to be found in *Comptes Rendus des Séances de l'Académie des Sciences*, vol. lvii., pp. 231 and 287.

**Aluminium in Batteries.**—I have tried the metal aluminium as a substitute for platinum, in a Grove's battery, and the experiment is quite successful. Two small cells, the size of the Al plates being 4 inches by  $1\frac{1}{4}$ , decomposed water very energetically. The metal aluminium possesses the advantage of costing (for equal surfaces) about one-tenth the price of platinum. I obtained it, price 5s. per ounce, cut to size as ordered.—W. NETTLETON.

**Tabachere.**—(Reply to Wm. Lant Carpenter.)—Tabasheer, as it ought to be written, is a Persian word signifying a concretion found in the joints of the bamboo, *Bambusa arundinacea*, said by Dr. Russell to be the juice of the plant thickened and hardened, by others to be pure silica. It is valued, in the East Indies, as a medicine for the cure of bilious vomitings, &c., but its effects are more imaginary than real. It appears to be mainly composed of siliceous matter which the plant is unable to incorporate in its tissues; its peculiar optical properties have been described by the late Sir David Brewster.

**Phosphate of Lime.**—I should be glad to be informed of the formula and equivalents of "bi-phosphate of lime" and "tri-phosphate of lime" respectively, anhydrous phosphoric acid being  $P_2O_5=142$ . In Williamson's "Chemistry" I find bi-phosphate given as  $CaH_4P_2O_8=234$ , and tri-phosphate,  $Ca_3P_2O_8=310$ , having the relation of 100:132.5, but in all analyses I have seen I find the equivalents taken as related to each other as 100:156 or 157. I should, therefore, be thankful to know the explanation of this apparent error. Is it connected with a professional or commercial usage?—W. TATE.

**Deodorising Oil.**—Sulphuretted Hydrogen Apparatus.—Can any of your correspondents inform "Nindex" (1) of a method for deodorising rape and colza oils? so as to fit them for use in perfumery, &c., where their peculiar odours are detrimental. Animal charcoal has been tried; its action is decidedly an improvement, but on rubbing the oil so treated between the hands the odour is then as persistent as before treatment. (2) What is the best form of  $H_2S$  apparatus for use in a small laboratory, opening on to a pharmacy where the public are continually coming in and going out, so as to prevent annoyance by its disagreeable odour. There is one figured by Fresenius and devised by Pohl; have any of your correspondents experience of the same, as that seems to be, theoretically, the best yet made known to me.—NINDEX.

## MEETINGS FOR THE WEEK.

MONDAY, 7th.—London Institution, 4. Dr. Odling, F.R.S., "On Chemical Action."

— Royal Institution, 2. General Monthly Meeting.

TUESDAY, 8th.—Ethnological, 8.

— Photographic, 8. Exhibition.

THURSDAY, 10th.—London Institution,  $7\frac{1}{2}$ . Dr. W. H. Stone, M.A., "On the Acoustics of the Orchestra."

## TO CORRESPONDENTS.

J. W. M.—You will find the information you require in Richardson and Watts's "Chemical Technology."

M. M. P. M.—(1) *Proceedings of the Royal Society*. (2) Thompson's "History of Chemistry."

*The Secretaries of the Ethnological and Photographic Societies* are thanked for the cards of admission which they have been good enough to send.

T. Corbett.—A reply has been sent by post.

**Post Office Irregularities.**—Since the introduction of the halfpenny postage, the complaints of delay in the transmission of the CHEMICAL NEWS have become very numerous. Our subscribers may rest assured that in all cases the fault rests with the Post Office authorities, and complaints should be addressed to them. We suffer equally in the irregularities in the receipt by post of our own periodicals.

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THE CHEMICAL and TOXICOLOGICAL CLASS will meet as usual every Monday and Thursday evening, at 8 p.m., commencing October 3rd.

The LATIN CLASS for the reading of Physicians' Prescriptions, Cæsar's Commentaries, &c., every Tuesday and Friday evening, at 8 p.m.

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# THE CHEMICAL NEWS.

VOL. XXII. No. 572.

## ON A CONVENIENT FORM OF SPECTROSCOPE FOR USE IN A LABORATORY.

By JOHN BROWNING, F.R.A.S.

THIS spectroscope is so constructed that it may be kept in close proximity to a chemical laboratory without injury. The prism is provided with a cover, which should be put on with a little bees'-wax; or, better still, bees'-wax and tallow. This prism, with cover complete, can be removed and replaced without deranging the adjustment of the instrument, to allow of a bottle prism being substituted for the purpose of taking the refractive index or dispersive power of any liquid. The stand of the instrument is of wood, and the whole is enclosed in a circular cover which fits tightly round the base of the instrument, and has no other joint or opening.

## REMARKS ON RICININE.

By RICHARD V. TUSON, F.C.S.,  
Professor of Chemistry in the Royal Veterinary College.

AMONG the "Chemical Notices from Foreign Sources" which appeared in the CHEMICAL NEWS of the 21st of October last will be found an extract from an article entitled "On Ricinine and the Active Principles of Ricinus Seeds," published in the *Pharmaceutische Zeitschrift für Russland*, No. 1, 1870. This extract contains the following statement:—"As regards the ricinine of Dr. Tuson, prepared by the author (Dr. E. Werner) in large quantity, and according to Dr. Tuson's directions, it is stated that ricinine is not an alkaloid, and, moreover, a substance which contains a considerable quantity of ash; and the author, after carefully made analyses, comes to the conclusion that Dr. Tuson's ricinine is a compound of magnesia and of an organic acid, the formula of this body being—



That the bodies obtained by Dr. Werner and myself from castor seeds are totally different I hope to render evident in the present communication.

I have in my possession two small specimens of ricinine; one was prepared from the so-called castor cake obtained from India, the other from castor cake obtained from Italy. These specimens possess the undermentioned properties:—

1. Cautiously heated on a glass plate they melt and form a colourless mobile liquid, which, on cooling, solidifies into a whorl of acicular crystals.
2. Heated between two watch-glasses they sublime, apparently without decomposition.
3. Strongly heated on platinum foil, they first melt, then burn with a highly luminous flame, and leave no ash.
4. Heated with solid potassium hydrate, they evolve ammonia, proving that they contain nitrogen.
5. On estimating the amount of nitrogen by Péligot's method, the specimen of ricinine procured from Indian castor-cake contained 20.79 per cent, while that from Italian cake contained 20.39 per cent.
6. A solution of ricinine in hydrochloric acid mixed with one of platinic chloride yields, on evaporation, well defined orange octahedra.
7. Cold saturated aqueous solutions of ricinine and mercuric chloride, if mixed together and allowed to stand, deposit fasciculi of acicular crystals.

A comparison of the foregoing epitomised account of ricinine with the description of the magnesium compound obtained by Dr. Werner from ricinus seeds, therefore clearly indicates that the two bodies are entirely different.

That ricinine is entitled to the appellation of alkaloid I hope yet to demonstrate by its complete investigation so soon as I shall become possessed of a large supply of castor cake, now, I believe, on its way from Calcutta.

## ON NEW ANALYTICAL PROCESSES.

By J. H. TALBOTT.

### I. On the Precipitation of Zinc and Manganese as Sulphides.

ZINC is thrown down from cold solution by an alkaline sulphide in the form of a slimy mass which settles slowly and is extremely difficult to wash. The precipitation is, however, more complete than when sodic carbonate is used, and may be rendered very easy and rapid by the following process:—The solution of zinc, if acid, is to be neutralised as nearly as possible by sodic or ammoniac carbonate. To the boiling solution, sodic or ammoniac sulphide is to be added, a large excess being very carefully avoided. The white precipitate, on continued boiling, soon becomes granular, and settles readily. The supernatant, clear liquid is then to be tested with a drop of the alkaline sulphide, to be sure of complete precipitation, and the sulphide then washed with hot water by Bunsen's method. The filtrate is perfectly clear, and absolutely free from zinc; the washing is easy and rapid. The sulphide of zinc is then to be partially dried with the filter, in the manner recommended by Bunsen, brought into a porcelain crucible, and ignited, at first gently, and afterwards strongly, with free access of air. The expulsion of the last traces of sulphuric acid is much facilitated by occasionally dropping fragments of ammoniac carbonate into the crucible. Pure ZnO finally remains, the ignition being continued until a constant weight is obtained. In this manner the following results were obtained:—

gr.		gr.
0.3216	pure ZnO gave	0.3216 = 100.00 per cent
0.3208	" "	0.3209 = 100.03 "
0.2412	" "	0.2410 = 99.91 "
0.1785	" "	0.1784 = 99.94 "

In zincic sulphate, which had probably lost a little water—

gr.		gr.
0.6485	gave	0.1851 ZnO = 28.54 per cent.
0.6510	" "	0.1858 " = 28.54 "
0.8198	" "	0.2338 " = 28.52 "

The formula requires 28.29 per cent ZnO. The advantages of this process over the older methods of precipitating in the cold are, I think, very evident, even if only the saving of time be taken into consideration.

Manganese may be precipitated completely from its boiling solutions by precisely the same process. The flesh-coloured sulphide is granular, and sometimes even sandy, though not distinctly crystalline, and may be washed with the utmost facility. The precipitated sulphide, after washing upon a filter, is to be re-dissolved in chlorhydric acid, and precipitated as ammonio-phosphate in the manner proposed by Professor Gibbs. To test the method with a perfectly definite salt of manganese, manganous pyrophosphate was selected, dissolved in dilute chlorhydric acid, and the solution nearly neutralised by sodic carbonate. To the boiling solution, sodic sulphide was then added, and the manganese finally weighed—in one analysis as pyrophosphate, in another as anhydrous sulphide—by ignition in a current of SH<sub>2</sub>. In this manner—



0.3132 gr.  $\text{Mn}_2\text{P}_2\text{O}_7$  gave 0.3126 gr.  $\text{Mn}_2\text{P}_2\text{O}_7 = 49.56$  per cent  $\text{MnO}$ .

0.3786 gr.  $\text{Mn}_2\text{P}_2\text{O}_7$  gave 0.2310 gr.  $\text{MnS} = 49.65$  per cent  $\text{MnO}$ .

The formula requires 49.64 per cent  $\text{MnO}$ . It is, perhaps, worthy of notice that ammoniac sulphide does not completely decompose manganous pyrophosphate under the circumstances above described. The greater portion of the salt is precipitated at once as crystalline ammonio-phosphate of manganese.

## II. On the Quantitative Separation of Tin and Tungsten.

The quantitative separation of tin from tungsten has always been regarded as a difficult problem not hitherto solved in a satisfactory manner. The following method will, I think, be found to leave nothing to be desired as respects both ease and accuracy. It depends upon the fact that stannic oxide,  $\text{SnO}_2$ , is reduced by potassic cyanide with great facility; while tungstic acid,  $\text{WO}_3$ , undergoes no reduction, even when heated with the cyanide to a high temperature. The oxides of tin and tungsten are to be heated in a porcelain crucible with three or four times their weight of commercial potassic cyanide, previously fused, pulverised, and thoroughly mixed with the two oxides. The mass is kept fused for a short time, when the tin separates in the form of metallic globules, while the tungstic acid unites with the alkali of the potassic cyanate and carbonate present. After cooling, the mass is to be treated with hot water, which dissolves the alkaline tungstate and other salts, and leaves the tin as metal. This is to be filtered off, washed, dried, and weighed as stannic oxide, after oxidation in the crucible with nitric acid. The tungstic acid is most conveniently estimated by the difference, but may of course be precipitated by mercurous nitrate, after boiling the solution with nitric acid to decompose the excess of potassic cyanide present, and then re-dissolving the precipitated tungstic acid by means of an alkali. To test the method, weighed portions of pure stannic and tungstic oxides were mixed and treated as above—

0.6662 gr.  $\text{SnO}_2$  and 0.5880 gr.  $\text{WO}_3$  gave 0.6679 gr.  $\text{SnO}_2 = 53.24$  per cent. The calculated percentage of stannic oxide is here 53.11.

0.7098 gr.  $\text{SnO}_2$  and 0.5460 gr.  $\text{WO}_3$  gave 0.7096 gr.  $\text{SnO}_2 = 56.51$  per cent, the calculated percentage being 56.52.

0.5378 gr.  $\text{SnO}_2$  and 0.4373 gr.  $\text{WO}_3$  gave 0.5405 gr.  $\text{SnO}_2 = 55.43$  per cent, the calculated percentage being 55.15.

0.5073 gr.  $\text{SnO}_2$  and 0.4334 gr.  $\text{WO}_3$  gave 0.5081 gr.  $\text{SnO}_2$  and 0.4349 gr.  $\text{WO}_3$ . This corresponds to—

	Found.	Calculated.
Stannic oxide .. ..	54.01	53.92
Tungstic oxide .. ..	46.23	46.08
	100.24	100.00

As it might, perhaps, be objected to the examples given above that I employed only purely mechanical mixtures of stannic and tungstic acids, and that this is not the case which occurs in practice, I made the following additional analyses:—Portions of the two metallic oxides were fused in a silver crucible with pure sodic hydrate; the fused mass was then dissolved in water, and the two oxides precipitated together from the solution by nitric acid with the usual precautions. The ignited mixed oxides were then fused with potassic cyanide, as above. In this manner—

0.7292 gr. of a mixture of  $\text{SnO}_2$  and  $\text{WO}_3$  gave 0.4211 gr.  $\text{SnO}_2 = 57.74$  per cent.

0.9826 gr. of the same gave 0.5661 gr.  $\text{SnO}_2 = 57.61$  per cent.

Tin cannot be separated from molybdenum by fusing the mixed oxides with potassic cyanide, as the molybdic acid is always more or less completely reduced to a lower oxide.—*American Journal of Science.*

## THE ISOMERS OF AMYL.

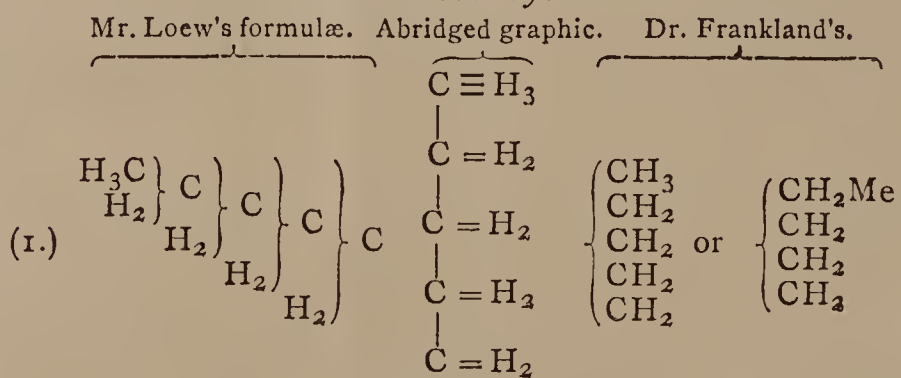
By HERBERT McLEOD, F.C.S., &c.

HAVING been much interested by Mr. O. Loew's communication, "On the Number of Isomeric Bodies," which appeared in the *CHEMICAL NEWS* of Oct. 7, may I be permitted to point out that the number of isomers of amyl has been somewhat over-estimated? for in the series of formulæ given, several cases occur in which the same compound is repeated, though in a different form. Mr. Loew professes to discard what he names the "theory of agglomeration and of the so-called binding and linking of atoms," though in the next column he speaks of two atoms of the same hydrocarbon being connected by a diatomic "radical," and follows Professor Kolbe in considering the hydrocarbons to be analogous to diamines and triamines which have a well-defined constitution. He thus virtually concedes the principle that he pretends to eschew. These differences of opinion on the rational formulæ of compounds are often mere questions of words and expressions, the same facts being symbolised in different ways; the formulæ indicating the same arrangement of the atoms among themselves, though the symbolic representations at first sight appear to differ entirely. Mr. Loew's formulæ will be found, on inspection, to be based on what has been termed the quadrivalent or tetrad character of carbon, and this will be seen by comparing the following corresponding expressions which have been suggested by various chemists. In the first place will be found the formulæ of Mr. Loew; in the second, a kind of abridged graphic formula, now much used, in which the symbols of the atoms which are directly combined with one another are joined by hyphens or short strokes; and in the third, the notation proposed by Dr. Frankland (*Fourn. Chem. Soc., N. S., iv., 372*), in which the grouping element is placed at the commencement of each line, and is directly combined with all the elements and radicals following it in the same line, the brackets indicating that the carbon atoms at the beginning of each line are directly combined with those above and below. To take the formulæ in the order in which they are placed in Mr. Loew's paper:

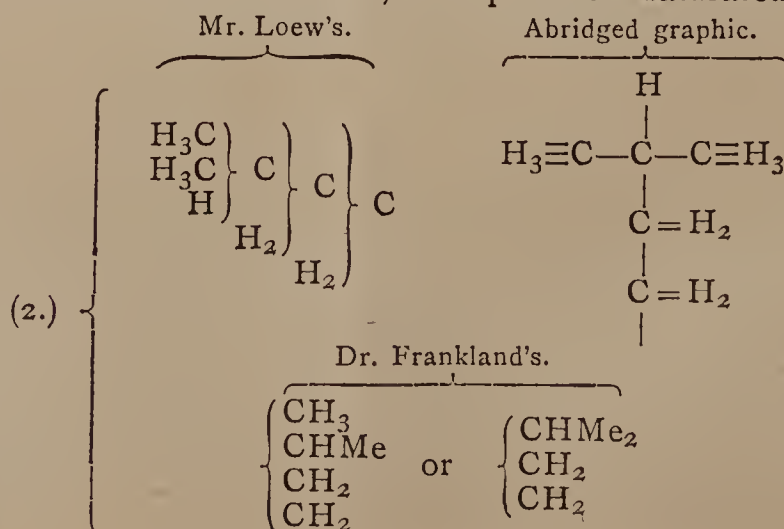
### Isomers of Amyl. $\text{C}_5\text{H}_{11}$ .

#### I. Monocarbolic Radicals.

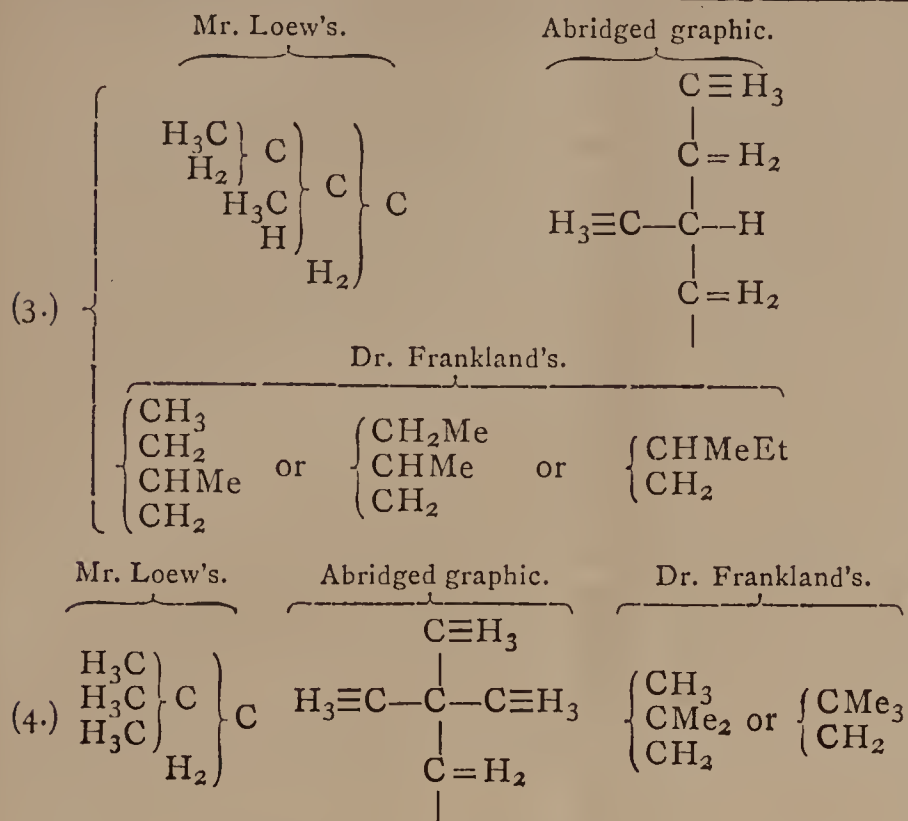
##### a. Primary.



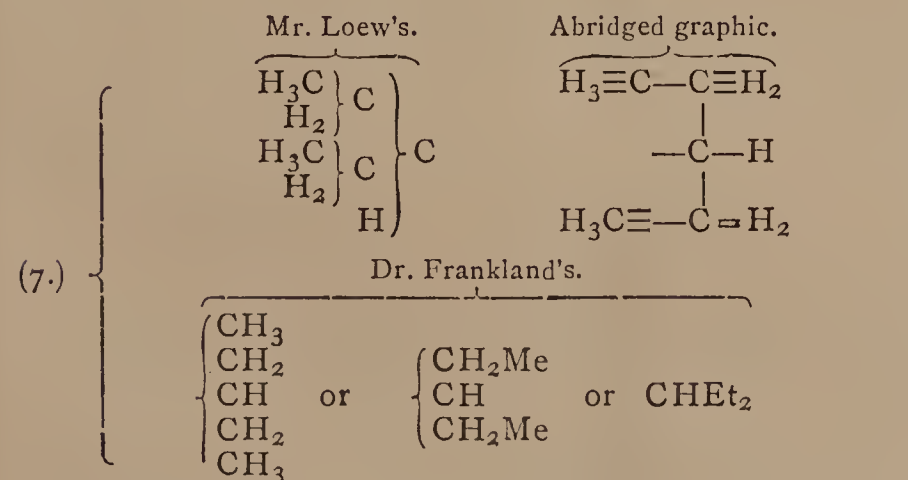
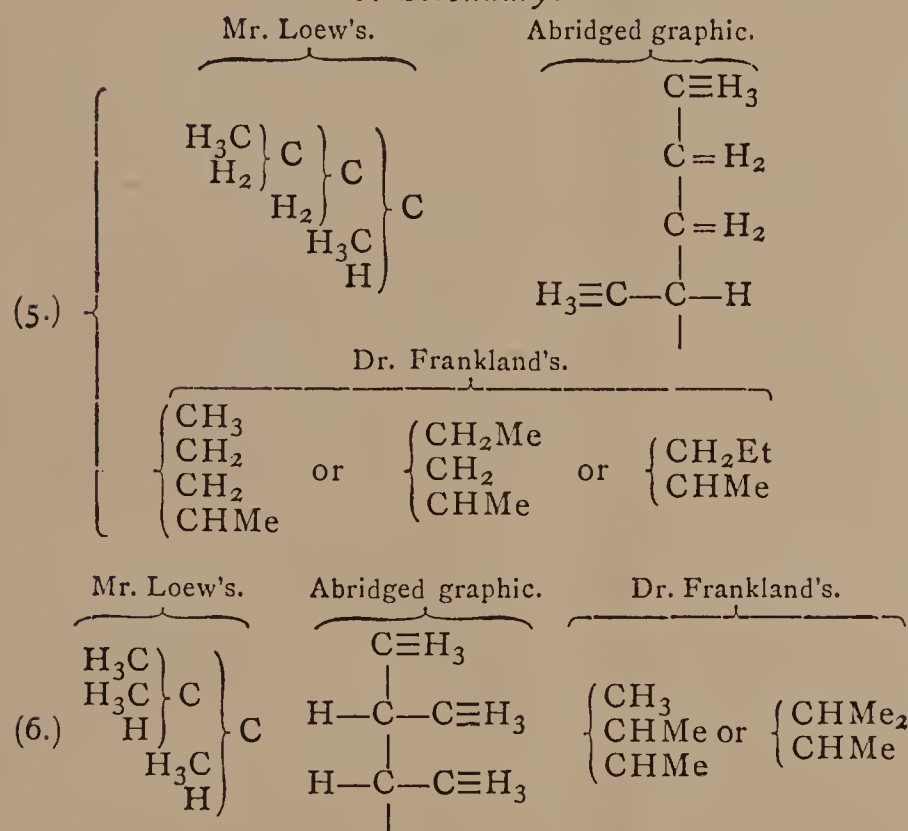
(It is by the last carbon in Mr. Loew's, and by the lowest one in the other two formulæ, that the radical is united to other radicals in amyl compounds; these are, consequently, semi-molecular formulæ, and represent unsaturated bodies.)





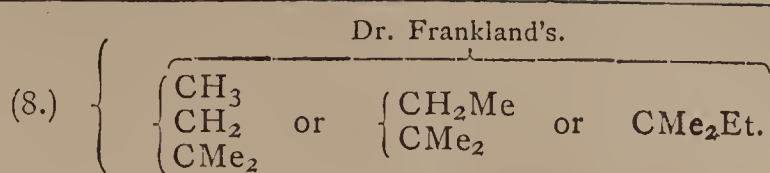
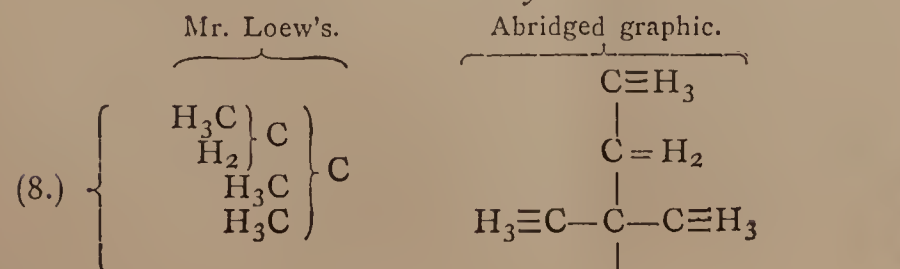


b. Secondary.



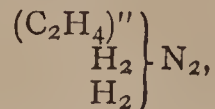
(In the last formulæ, it is the centre atom of carbon that unites with other radicals.)

c. Tertiary.

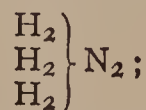


II. Dicarbolic Radicals.

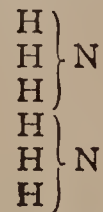
These, we are told, resemble, in constitution, the diamines, two atoms of carbon being connected by a diatomic radical. As an example of a diamine, we will take ethylene-diamine—



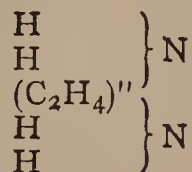
which may be considered as a derivative of diammonia—



but the diamine may equally well be regarded as obtained from two molecules of ammonia—



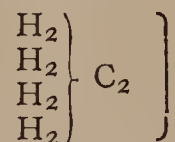
by the substitution of the diatomic radical ethylene for one atom of hydrogen in each of the ammonia molecules—



and thus connecting the atoms of nitrogen.

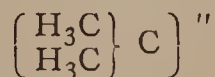
This latter assumption is the most probable, as diammonia does not exist; and the second formula indicates that the nitrogen atoms are not directly combined with one another.

On treating Mr. Loew's formulæ for the dicarbolic isomers of amyl in a similar manner (and which obviates the necessity of assuming the existence of *di-marsh gas*—



it will be seen that they are identical with the preceding monocarbolic bodies.

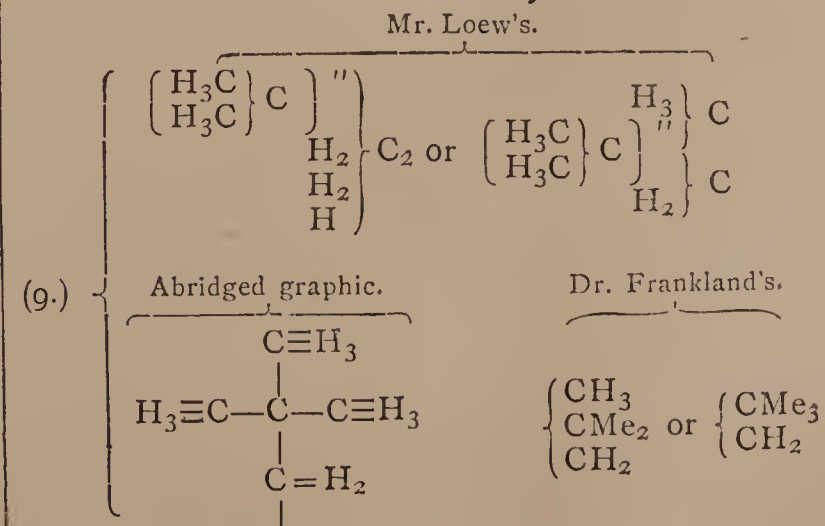
In the first, the diatomic radical is—



and, as there remain five atoms of hydrogen to be divided between two atoms of carbon, two must be associated with one of the carbon atoms and three with the other.

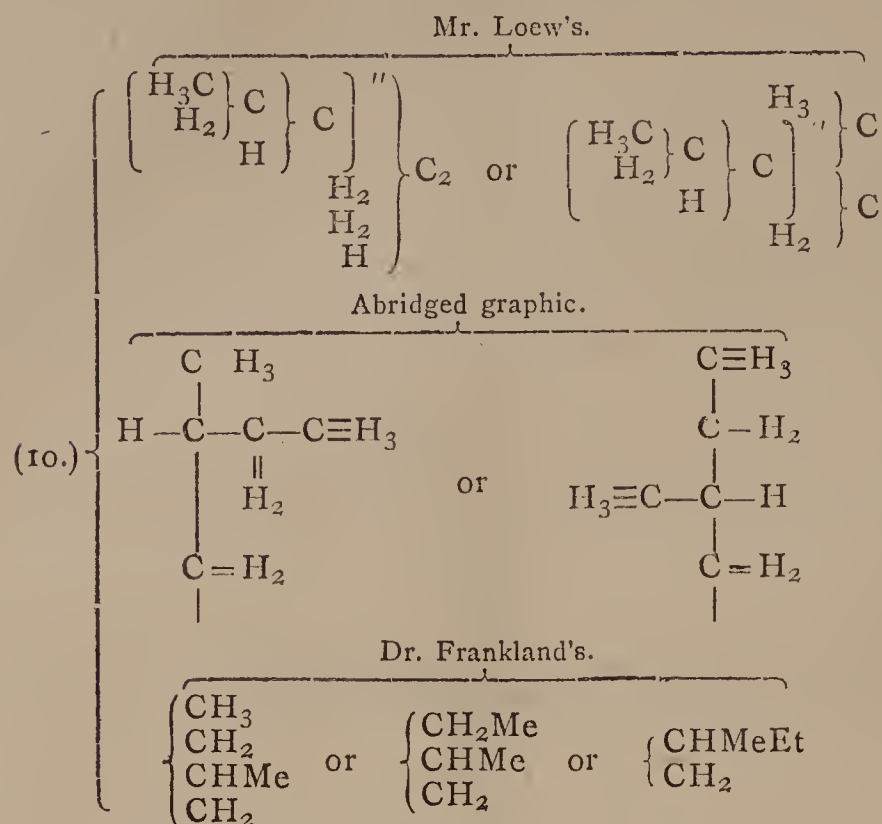
Dicarbolic Radicals.

a. Primary.



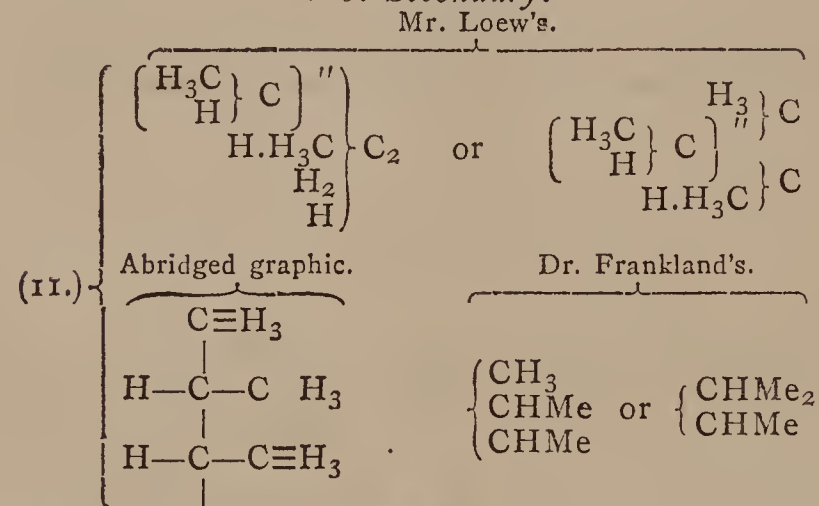
This is identical with No. 4.



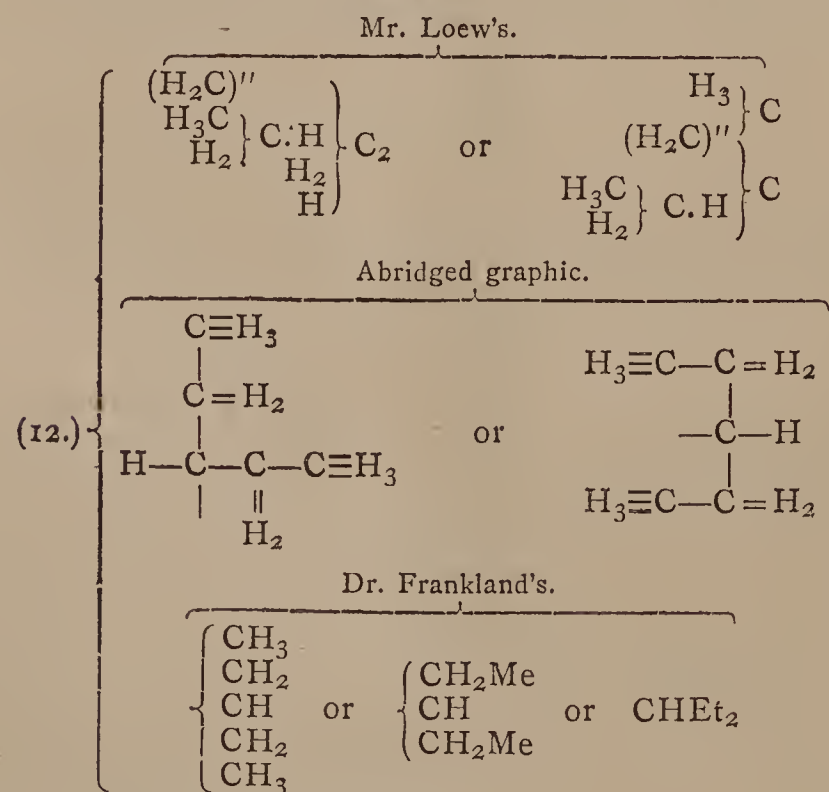


This is identical with No. 3.

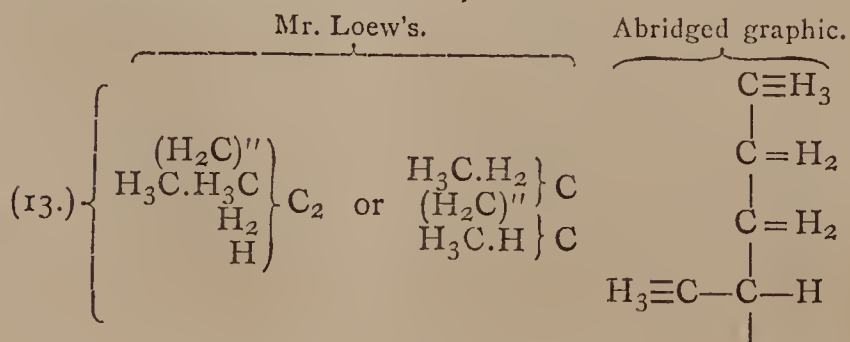
## b. Secondary.



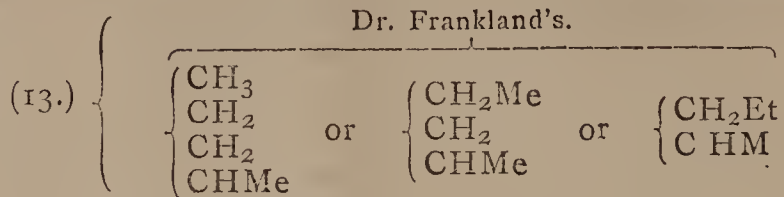
This is identical with No. 6.



This is identical with No. 7.



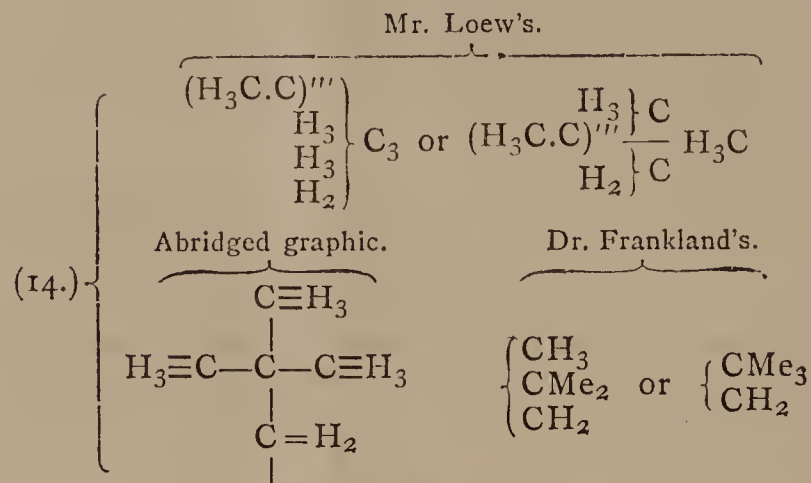
Dr. Frankland's.



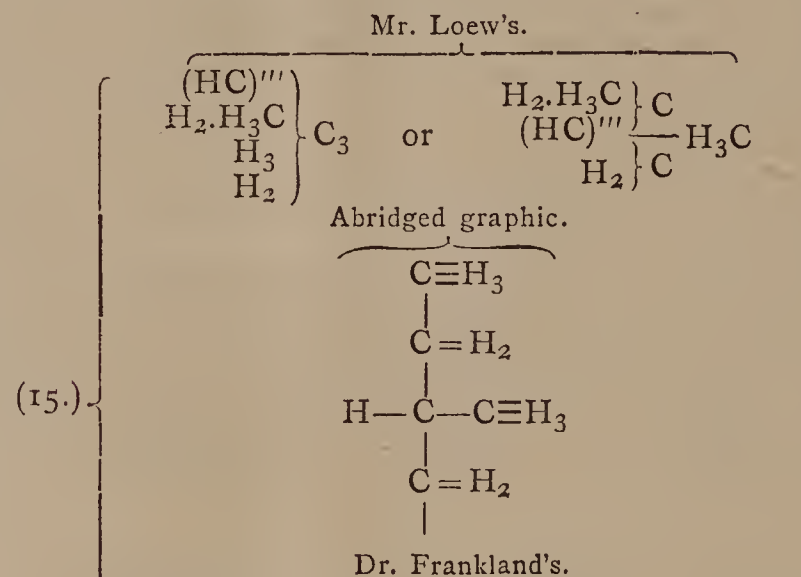
This is identical with No. 5.

## III. Tricarboic Radicals.

By formulating these in a similar manner, we have—

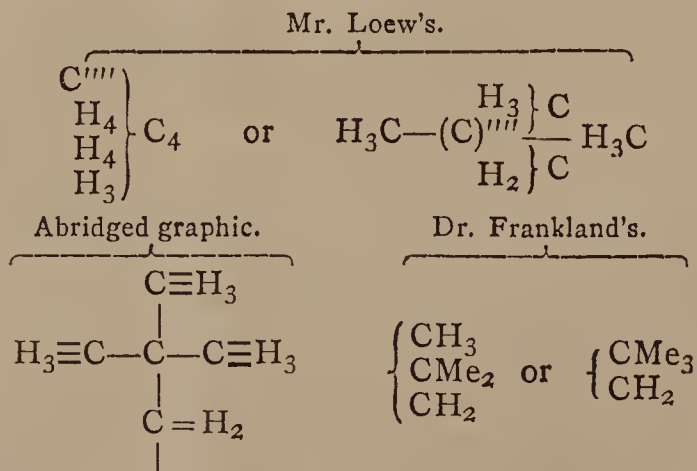


This is identical with No. 4 and No. 9.



This is identical with No. 3 and No. 10.

## IV. Tetracarboic Radical.



This is identical with No. 4, No. 9, and No. 14.

From this it will be seen that, with our present knowledge of the characters of carbon, we cannot conceive of more than eight isomers of amyl.

There is only one variety of methyl; one of ethyl, which may be viewed as methylated methyl,  $\text{CH}_2\text{Me}$ . There are two propyls:—normal propyl, which is ethylated methyl,  $\text{CH}_2\text{Et}$ , and isopropyl, or dimethylated methyl,  $\text{CHMe}_2$ . There are four butyls:—normal butyl, or propylated methyl, containing normal propyl,





another primary butyl, containing isopropyl—



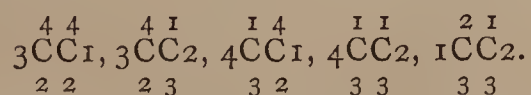
a secondary butyl, methylated ethylated methyl,  $\text{CHMeEt}$ ; and lastly, a tertiary butyl, trimethylated methyl,  $\text{CMe}_3$ . In the eight amyls above given, we have in the four primary ones the four varieties of butyl, No. 1 containing normal butyl, No. 2 the isopropylated methyl, No. 3 contains methylated ethylated methyl, and No. 4 trimethylated methyl. Of the secondary amyls, the first, No. 5, contains methyl and propyl; the second, No. 6, methyl and isopropyl; and the third, No. 7, two of ethyl. In the tertiary amyl, No. 8, the three hydrogens of methyl are replaced by two of methyl and one of ethyl, it being dimethylated ethylated methyl.

These views will require to be very much extended if it should be distinctly shown that the four attractions of carbon differ, or, what comes to the same, that the four hydrogen atoms in marsh gas have different functions. Up to the present there are very few cases of isomerism which may not be explained by the assumption that these atoms are of equal value; there being, however, two most important exceptions in Bunsen's methylic bromide, and in the isomeric ethylic chloride obtained by acting on ethylic hydride by chlorine. If, however, the four hydrogen atoms in marsh gas have different properties, the number of isomers will be increased to a prodigious extent. By replacing one of these atoms by chlorine, four different methylic chlorides would be possible. In the next series the number of ethylic chlorides would be very much greater. The isomerism may perhaps be illustrated by numbering the

four attractions of carbon, thus,  ${}^1_4\text{C}_2$ ; then the four methylic chlorides will be formed by the chlorine being in the position of one of the numbers 1, 2, 3, or 4, the three remaining positions being occupied by hydrogen; there will consequently be four varieties of the radical methyl depending on the attraction which is occupied in joining the group to other radicals. Now let us imagine the molecule of methyl in the free state produced by the union of two semi-molecules,

by the attractions marked 1, we shall have  ${}^4_2\text{CC}_3$ . Three ethylic chlorides are now possible according as the chlorine takes a position at 2, 3, or 4. But the carbon atoms may be united by the attractions marked 2, the methyl  ${}^4_3\text{CC}_4$  will thus be formed; this will also form 3 chlorides: the other two possible formulæ are  ${}^2_4\text{CC}_1$  and  ${}^3_1\text{CC}_2$ , each giving three chlorides, or 12 in all. But we may go even farther;

attraction 1 may unite with attraction 2, producing  ${}^4_2\text{CC}_4$ ; and in a similar manner there might be formed—



Thus we should have ten varieties of hydride of ethyl, or methyl, each capable of producing three ethylic chlorides, or a total of no less than thirty. In the propyl series the number would be vastly greater, but it will not be necessary to occupy more space in developing these isomerisms, more especially as they are perfectly hypothetical.

From the foregoing it will be seen that the lightly esteemed "theory of agglomeration and of the so-called binding and linking of the atoms," or, as it has been termed, "the interlacement of tentacles," is competent to explain almost all the isomerisms with which the chemist is already acquainted and to direct the experimenter on the track of new discoveries. The very few cases of isomerism in the methyl and ethyl series that have been clearly established would seem to indicate that there is no need to resort to such complicated explanations as those just given; but it must be remembered that if such isomers did exist their

differences would be very slight, and we may not at present have arrived at the knowledge of the means of distinguishing them. Already, in the case of two of the valeric acids, molecular weights, vapour densities, specific gravities, boiling points, and odour have failed us, and recourse must be had to the action of the bodies on polarised light in order to distinguish them from one another.

Royal College of Chemistry, London.  
October 16, 1870.

## ON SOME OF THE COLOURING MATTERS OF MADDER.

By Dr. F. ROCHLEDER.

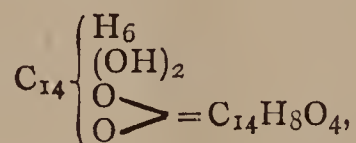
WHEN madder has been treated with mineral acids aided by heat, or, as it is technically called, has been converted into garancine, it contains, beside alizarine and purpurine, a yellow-coloured crystalline matter, which, in the underground root, is present as a glucoside. The quantity, however, of this substance is only small, and it requires thousands of pounds' weight of madder to obtain a few drachms of the mixture containing this yellow material. I received, from M. W. Brosche, a manufacturer, the raw material, which served me for the purpose of my experiments, in the shape of a brownish yellow, hard, specifically light, and readily pulverisable substance. I cannot here enter into any discussion, nor explanations, as regards the relation of the substances which I isolated from this raw material to the bodies Dr. Schunk found in his so-called rubian, and to the materials found by Dr. Schützenberger in commercial purpurine, since the analyses of the substances alluded to do not agree sufficiently mutually for this purpose. The raw material I obtained was soluble in caustic soda solution, exhibiting a blood-red colour; hydrochloric acid precipitates from this solution a bulky, gelatinous, dirty yellow-coloured flocculent matter, which, after boiling, loses its gelatinous property sufficiently to admit of collection on a filter, and of being readily washed after cooling. The solution in alkali, and the precipitation by acid, are required in order to render the material more readily acted upon by solvents. On being treated with baryta-water, the greater part of the material left on the filter is dissolved, while only a small quantity remains as a nearly black-coloured powder; the separation of these substances is effected by filtration. While I intend to say more about the blackish coloured substance hereafter, I for the present only occupy the attention of my readers with the four substances the baryta compounds of which are soluble in water. The blood-red coloured baryta-water solution is precipitated with hydrochloric acid, and the fluid containing the precipitate is heated to boiling, in order thereby to counteract the gelatinous consistency of the precipitate, which is next brought on to a filter and washed with water. The precipitate, while yet moist, was somewhat dried between folds of blotting-paper, and next heated with hydrate of acetic acid in sufficient quantity to effect a thorough solution; on cooling, this acetic acid solution solidifies, exhibiting crystalline structure. This material was placed on a filter and washed with cold acetic acid as long as the liquor running through exhibited the colour of a solution of bichromate of potassa. By this treatment, an amorphous, resinous substance, which is soluble in cold acetic acid is removed, while hardly anything else is rendered soluble. The reddish coloured solution thus obtained yields, on being diluted with water, a yellow-coloured glutinous precipitate, the quantity of which is, however, too small to make it worth while to treat it for any crystalline substances which might be contained therein. The lemon-yellow coloured mass which is left on the filter was first fractionally crystallised from a boiling mixture of acetic acid and water; next, the substances thus obtained were fractionally crys-



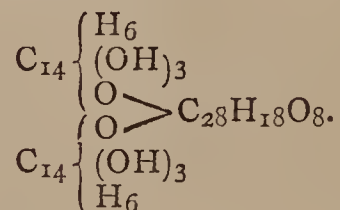
tallised by means of boiling alcohol; and were next, again, by means of partial solutions in alcohol and water, separated into various compounds. It would lead too far to explain here the applications of ammonia, carbonates and bicarbonates, chloride of iron, &c., used by me for the purpose of separating the substances. The four bodies which I have isolated from each other are, as regards their behaviour with solvents, so nearly related to each other, that their separation can only be effected by frequently repeated and tedious operations; and, as regards their properties, too, they are so akin to each other that only by a series of analyses I could find out whether they required more purification. I only obtained small quantities of the pure substances, and hence it was impossible so fully to investigate their relations as to deduct therefrom results in respect of their constitution. The product present in the mixture to the largest extent, after the removal of the resinous body alluded to, is isalizarine, because it has the same composition as alizarine, from which it is, however, distinguished by its blood-red colour when in solution in aqueous solutions of caustic soda and potassa, and by its red colour when dissolved in baryta water. The colour of this substance holds the middle between those of alizarine and purpurine. It does not dye cotton previously mordanted with iron or alumina mordants; it cannot be obtained in large crystals. The four following analyses refer to materials obtained by a different mode of preparation:—

Calculated.		Found.			
		I.	II.	III.	IV.
C <sub>14</sub> = 168	70.00	70.18	70.02	70.03	70.01
H <sub>8</sub> = 8	3.33	3.61	3.62	3.65	3.61
O <sub>4</sub> = 64	26.67	26.21	26.36	6.32	26.38
				2	
	240				
	100.00				

Isalazarine is accompanied by a second material present in the raw material, in so extremely small quantity that I could only just manage to make one analysis, which led to the formula C<sub>15</sub>H<sub>10</sub>O<sub>4</sub>. This material may be readily confused with isalazarine, and its presence in that substance explains the somewhat too high proportion of H found in isalazarine. A third companion of isalazarine is hydrisalazarine; its colour is rather more bright yellow than that of isalazarine. It (hydrisalazarine) is soluble in a boiling solution of perchloride of iron, with a dark brown colour; it partly precipitates on cooling, partly on addition of a few drops of hydrochloric acid, in the shape of a bright yellow-coloured flocculent matter; it is not at all changed or altered in any way by its solution in the chloride. Four analyses led to the formula C<sub>18</sub>H<sub>18</sub>O<sub>8</sub>. When alizarine is written—

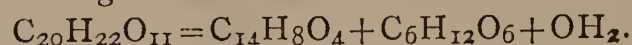


hydrisalazarine is expressed by—



The fourth companion of isalazarine and the two other substances alluded to is homologous with hydrisalazarine, according to the formula C<sub>29</sub>H<sub>20</sub>O<sub>8</sub>. When this substance is kept for some time at from 118° to 120°, it loses OH<sub>2</sub>, thereby assuming a more dark colour. I take this opportunity of calling attention to the composition of ruberythrinic acid, found by me now many years ago in madder; its composition is correctly expressed by C<sub>20</sub>H<sub>22</sub>O<sub>11</sub>. By the action of acids, this substance, as was then pointed

out by me, is converted into alizarine and sugar, according to the following formula:—



—*Berichte der Deutschen Chem. Gesell. zu Berlin.*

## ON FERMENTATION.\*

By Professor A. W. WILLIAMSON F.R.S.

### LECTURE I.

I HAVE sometimes wished, when building castles in the air, that I could, after a few hundred years, come back and see the state of science at that time. I am convinced that those who will look back, from such a period as a few hundred years hence, at the present state of our knowledge of nature in any one department will be surprised at its smallness; in fact, even now, when we work at all earnestly at any one part of the field of nature, we cannot refrain from feeling how little is our knowledge compared with our ignorance. But, if that is generally the case, I think it is peculiarly the case in those studies in which life is concerned; and the phenomena of fermentation have that peculiarity that they consist in processes in which vital organisms are concerned, and in which there is every reason to believe that vital organisms, or living beings, take an active and leading part. I need not say that, for that reason, the explanations which we have, even of the simplest and best known of the phenomena of fermentation, are, as yet, mere sketches of the reality. It is, however, not the less useful or the less important to know them for that reason.

When we chemists are classifying substances, we adopt a principle of classification which I think is almost inevitable, but it may be as well that I should mention what it is. We put the simple things together, and the complex or difficult things together, and then we try to put between them, in as regular an order as possible, the intermediate links of the chain by which they can be connected; and I believe that our best—I might almost say our only—explanations consist in thus arranging, in a natural order, the facts which we have to consider, and then viewing them, and stating what we see, in the clearest and least ambiguous terms. Now, the term “organic,” as applied to a certain class of chemical substances, might be replaced—and I think, for some purposes, ought to be replaced—by the term “complex.” The substances which we are in the habit of including under the term organic are peculiarly complex; in fact, they are the most complex with which we have to do. The phenomena of fermentation relate mainly to them, and consist principally of a process of change—the breaking-up of those organic bodies into rather less complex substances than themselves—a process of partial analysis. Of course, when I say that, I give what I conceive to be a characteristic idea of the general method, and I must not be supposed to assert that all processes of fermentation are analytical.

Amongst the characteristics which I think are particularly useful and interesting, as serving to distinguish organic from inorganic, complex from simple substances, is their different behaviour under heat. I have found it exceedingly interesting and instructive to bear in mind the fact that, while simple and inorganic compounds, as we generally call them, are sometimes destroyed and resolved into other compounds by the action of a high temperature, yet many of them are not. Amongst inorganic substances we find some which are broken up or changed by exposure to a high temperature, but there are others which can stand even the highest temperature without undergoing any permanent change; that is to say, they return, on cooling, to the same state in which they were before the heat was applied. With organic substances that is not the

\* The Cantor Lectures. Delivered before the Society of Arts.



case. All organic bodies are broken up into minute particles, and assume new arrangements, when they are heated to a sufficiently high temperature; and that is, I think, a distinction which is of considerable theoretical, as well as, perhaps, of some practical, importance.

The processes of breaking up which are effected by heat upon organic bodies are, in the very great majority of cases, different from those which are effected by the action of these wonderful little organisms, the ferments; and it is a peculiarity of the action of the ferments that they effect the breaking up—the analysis—of complex organic substances, and form products which, for the most part, we have obtained from those materials by no other process.

Amongst the processes of fermentation, there is one which, from its pre-eminent importance, and from the fact that we have had occasion to study it more fully than any other, ought to be first mentioned. I allude to the process of fermentation by which alcohol is formed artificially. I may say, indeed, it is the only process by which alcohol is ever made. It is a process which consists in breaking up some kind of sugar, for sugar is a word which, although popularly restricted to one particular substance which is extracted sometimes from the sugar-cane and sometimes from beet-root, is used by chemists in a more general sense, serving to characterise a family of bodies which have much in common with one another, being for the most part all of them sweet, and containing the same elements, but in slightly different proportions. They all possess many properties which are of some importance. These different kinds of sugar are broken up by the action of ferment into alcohol, and also into another product, carbonic acid gas, which has been long known, and for a long time the process of alcoholic fermentation was supposed to consist simply in a separation of sugar into these two products, alcohol on the one hand and carbonic acid on the other. A more careful examination of the products has shown, however, that these two never appear alone. I believe I may safely say, from the researches of Pasteur and others, that no case of the formation of alcohol by fermentation has been known to occur in which several other products have not been formed simultaneously with these two. With regard to the difference of properties of these two bodies, there are one or two points of some little interest, especially this one, that whereas alcohol is an eminently combustible substance, and is well known to have properties of that kind, being frequently used as fuel, on the other hand, carbonic acid, the other chief product, is completely burnt—it is a substance incapable of undergoing any chemical change whatever analogous to combustion. Alcohol is a substance which I need not show you, although in its pure state it is not very common, but I will, in order to remind those of you who may be less familiar with its leading properties, make a little carbonic acid by a short process. I will put a little muriatic acid upon some white marble, and the apparent ebullition which you see takes place is known to you all as due to the liberation of carbonic acid. You might imagine the thing to be fermenting, only that the process in that case would be less rapid. Now, if I plunge this little burning paper gradually into the jar containing the carbonic acid, it will burn more and more faintly, and get extinguished when it enters the gas; it is totally impossible to set fire to the gas. And there is one other fact that we may notice at the same time—the great specific gravity which characterises this gas. I will show you that, in this way. I will go through the motion of pouring from this jar containing it into another smaller jar; and no doubt the heavy carbonic acid will pass from the jar in which I first collected it into the lower one, where we shall find it by means of the taper as before. You see that, on lowering the lighted taper into this small jar, it is extinguished as it was before. I will show you the test by which we usually discover the presence of carbonic acid. I have here some water containing lime in solution—some lime-water—and I will pour it into the large beaker-glass, in which there is probably still some carbonic acid left. You see the solu-

tion immediately becomes turbid, or, as we express it, a precipitate is formed by the combination of the carbonic acid with the lime-water. A compound is formed, which is nearly insoluble in the water, called carbonate, which goes down as a precipitate.

In addition to alcohol and carbonic acid, I ought to mention another kind of alcohol, which occurs to a considerable extent in some distilleries where raw grain or potato-starch is used. This substance imparts to the product a very unpleasant odour, and some unwholesome qualities. It is known by the name of fousel oil. It does not mix with water; and if I were to pour some of it on water, it would float, without dissolving to any considerable extent. There are some other products which are even more interesting and important; two especially I ought to mention. One is the clear substance which you see in this bottle, and which you might imagine to be oil; it is a fluid largely made now, and known by the name of glycerine, but in chemical language I should say that this was an alcohol. It is a substance which, by tasting, you might mistake for sugar, for it possesses a sweet taste, resembling sugar; but, to chemists, it is a kind of alcohol, and its appearance during fermentation together with ordinary alcohol is no doubt due to a process of the normal kind.

Another product which I might compare to the carbonic acid which I just now showed to you, is this beautiful crystalline acid substance, which has long been known by the name of succinic acid. It got that name from the fact that it was originally prepared from amber. By subjecting the amber to dry distillation, succinic acid, among other products, is formed. Glycerine and succinic acid, as well as common alcohol and carbonic acid, are always formed when any kind of sugar is made to decompose by the process which is termed alcoholic fermentation, and it is seldom that there are not other—and probably, in smaller quantities, several other—products formed besides those four. In fact, the different kinds of spirit which are obtained by the process of fermentation, and subsequent distillation—I mean those kinds of spirit to which no artificial flavouring is added (gin is a general name given to certain spirits which are flavoured by artificial means), such as brandy, rum, and others—owe their distinctive peculiarities to the presence of small quantities of volatile substances which are formed during the process of fermentation, regarding which a good deal has been observed, and several important facts have been collected.

There is another process of fermentation which I must mention, for it is important from its frequent occurrence, and that is a process by which another kind of sugar usually, but sometimes common sugar, is transformed. The substance which most naturally undergoes this fermentation is milk-sugar. These hard lumps in this bottle, which, if you were to take out and taste, you would not imagine to be sugar, are made by the crystallisation of the solid substance in whey. The whey is evaporated carefully to a small bulk, and this substance which results is known by the name of milk-sugar. When a solution of this is mixed with cheese, which is the best ferment for the purpose, it gradually turns acid. I dare say it is known to all of you that milk itself, which contains this body, and cheese, or rather caseine dissolved with it, together with the fatty globules of milk, when exposed to the air, turns acid. That acidity is due to a change which takes place in the sugar. The sugar disappears gradually, and is transformed into an acid substance, of which I have a little bottle here. It is a strong acid; and here, in another bottle, are a few of its salts—a lime salt and a zinc salt, which is a very beautiful and characteristic compound. I shall have occasion hereafter to show you a large bottle which is now at work, in which I dissolved, not this particular kind of sugar, but the ordinary sugar. I put with it a quantity of calcic carbonate, and some old lean cheese, with a considerable quantity of water. The mixture was kept at a temperature above blood heat for some considerable time, and a compound of lactic acid is being formed. That is a process analogous in its general features to the fermentation



which forms alcohol, but it is a change of sugar in which no alcohol is formed. Sometimes there is a trace of alcohol, but there is not necessarily any, and no carbonic acid is formed; but, instead of those products, the elements of the sugar break up into different groups and arrange themselves in another manner. That is really the nature of the process, as far as our most careful experiments have gone; and the acid which we make in that way, which is lactic acid, or acid of milk, is really sugar, of which the elements are arranged in a different way, so as to acquire acid properties.

The third process, which I must mention from its remarkable products, is one which, perhaps, in some respects, ought rather to be compared with putrefaction, for it is a process which has many of the most important characteristics of putrefaction. In order to deal with the question of fermentation generally, it is necessary to allude to some varieties of such chemical changes which are usually classed under the term putrefaction. As a general rule, I think the characteristic of processes of putrefaction is mainly the unpleasant nature of the products which are formed. It is not long since a distinguished chemist, in speaking of alcoholic fermentation, said that it is really a putrefactive process; and in its intimate nature it is, as far as we know, a process much like the truly putrefactive processes, and different from the processes of *eremacausis* or oxidation. This other process to which I allude consists in forming the acid substance which I have here, and which I will not open, because it is not a very pleasant body; it is a substance which is known, although I believe not very commonly, in butter. The peculiar rancid odour which butter acquires when it is kept too long, especially in warm weather, is due to a transformation of some of its materials into this particular acid, which Chevreul, a very distinguished French chemist, separated from butter, and he named it, from that circumstance, butyric acid. If we leave some of this product of the last fermentation—some of this lactate of lime, the lime-salt of lactic acid—under the same conditions in which it was formed, that is, if we leave it in the same vessel in which it had been formed from the milk or sugar, and leave cheese with it, and keep the mixture warm, the lactate will gradually decompose, and carbonic acid will be given off together with hydrogen gas; and, at the same time, we find that the lactic acid will be decomposed, and in place of it we get this butyric acid, and generally some valerianic acid and a little acetic acid.

(To be continued.)

## ON THE ESTIMATION OF MANGANESE.

By Dr. MOHR.

SOME discrepancies in the results of analysis of manganese, especially that imported from Spain, have been noticed, according as the method of analysis (quantitative estimation of peroxide of manganese) employed was that of Fresenius and Will, or that known as the iron test. The cause of this discrepancy has been found to be due to a larger or smaller amount of magnetic oxide of iron present in and along with the manganese ore. When the method of Fresenius and Will is applied to the estimation of manganese this admixture of oxide of iron is quite indifferent, because neither of the oxides of that metal exert any action upon oxalic acid; but when the so-called iron test is applied for the purpose alluded to, the protoxide of the magnetic iron ore is converted into chloride, and there remains, therefore, a correspondingly larger quantity of the double salt of iron which has been added. Since the same reaction occurs when such a manganese is applied for the manufacture of chlorine, and since the quantity of the latter gas set free is only that which remains after the oxidation of the magnetic iron ore, the manufacturer who purchases such manganese is entitled to pay for that

article only its value as peroxide of manganese. It, however, frequently occurs that the mining and manufacturing interests here clash, and that, as a consequence, the ore proprietor will desire the value of his material to be estimated by the method of Fresenius and Will, while the manufacturer prefers that of the iron test. That right as well as equity are on the manufacturer's side is clear from the following instance:—Suppose a mixture of one atom peroxide of manganese, ( $\text{MnO}_2$ ), and two atoms magnetic iron ore,  $2(\text{Fe}_3\text{O}_4)$ , or 27.3 per cent of the former along with 72.7 per cent of the latter; in such a mixture the method of Fresenius and Will will indicate with precision the amount of peroxide of manganese, but on adding hydrochloric acid to this mixture not a trace even of chlorine will be given off, since the free atom of oxygen of the peroxide of manganese is just sufficient for the oxidation of the two atoms of protoxide of iron of the magnetic iron ore; in the same way a mixture of manganese with protosulphate of iron or protocarbonate of that metal will be perfectly worthless as an article for the chlorine-making use.

The author recommends that manganese ores and samples of peroxide of manganese should be always tested, previous to analysis, with an astatic magnetic needle, and he further recommends as the best and surest method of analysis of peroxide of manganese, the following:—Distillation of the ore with hydrochloric acid, collection of the chlorine gas given off in an aqueous solution of iodide of potassium, and estimation of the iodine set free by means of a 1-10th solution of hyposulphite of soda; this process is really the same as that which the manufacturer employs for making chlorine; any magnetic iron ore present will become oxidised in both these processes (the testing just described and the chlorine making on the large scale), and an examination for magnetic oxide of iron is rendered unnecessary, while the available manganese for the production of chlorine only is estimated.—*Zeitschrift für Analyt. Chemie.*

## ON THE ABSORPTIVE PROPERTIES OF SILICA, AND ITS DIRECT HYDRATION BY CONTACT WITH WATER.

By W. SKEY,  
Analyst to the Geological Survey of New Zealand.

IN No. 157 of the CHEMICAL NEWS, I communicated the fact that silica is hydrated and dissolved by aqueous solution of ammonia. Evidence in favour of this being given in a recent number of the same journal, together with particulars as to the amount of this solubility, I thought it desirable to ascertain whether ammonia is absolutely necessary to ensure this, the first of these reactions, the hydration of the silica; it occurred to me that water might effect it of itself—the action of ammonia, in this instance, being confined to bringing the silica, thus hydrated, into solution.

The following experiments tend to show this assumption to be correct:—

Rock-crystal, finely pulverised in an agate mortar, then agitated with water, did not completely subside, even after the lapse of some days; the water remained turbid, like clay-water, and, like it, is soon clarified by the addition of an acid or a neutral salt.

The effects of such additions would, I conceive, rather retard the precipitation of the silica, by increasing the gravity of the fluid, were it not that combination between the silica and the water had commenced—were it not, also, for an affinity of this substance for water under these conditions—feeble, no doubt, as to intensity, but insatiable as to quantity.

There appears to be one weak point in the evidence here tendered—viz., that agate (the substance of the mor-



tar used) is not pure silica; still, it is so nearly pure, that, upon the whole, it is, I think, quite safe to leave this matter out of further consideration.

In reference to other absorptive properties of silica, I find that massive quartz, rock-crystal, and silica, prepared for estimation in the usual way, take sesquioxide of iron from solution of its acetate, but not from the chloride.

Prepared silica, especially, manifests this property, if ignited at a low temperature; and, besides, takes oxides of chromium and copper from their acetates, and removes certain organic matters from their aqueous solutions. These reactions are more apparent in this case, because the silica is in a finely divided state, *chemically* pulverised in fact.

These reactions show silica to be a feeble mordant, and I think they have an intimate relation to what is termed the physico-mechanical absorption of soils, &c., since we thus see that one of the main constituents of rocks and soils, supposed to be at once the most inert and the most insoluble in an ordinary way, are capable of chemically absorbing certain substances to an extent proportionate to that of the surfaces exposed; such surfaces, even those of rock-crystal itself, are certain to be in a hydrous, in fact in a pulpy state, whenever water has had prolonged contact with them. It follows, therefore, if a substance, which has hitherto been held to be so inert and so unassailable, in these respects, as quartz, is thus actually affected in this manner, we may be certain that the great bulk of our soils, and our more porous rocks, have been affected by water and saline substances in a similar manner;—we may be quite certain that the surfaces of every siliceous stone, and of every grain of siliceous sand in our soils, is hydrated, and, by so far, advanced to the possession of what is termed the physico-mechanical absorptive power for plant-food.

It only remains for me to state that the reactions here described tend to resolve the so-called "*physico-mechanical* absorption of soils for plant food," into a simply chemical one, or at least, as much a chemical one as are any of those undisputably recognised as such.

## PROCEEDINGS OF SOCIETIES.

### CHEMICAL SOCIETY.

Thursday, November 3rd, 1870.

Professor WILLIAMSON, F.R.S., President, in the Chair.

THE following gentlemen were elected Fellows:—  
D. Howard, J. Muter, C. W. Siemens, F.R.S.

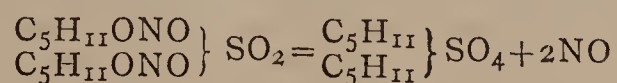
On opening this first meeting in the new session, the President alluded, in a few earnest words, to the loss the Society had recently sustained through the death of two of the most distinguished of its members.

The following papers were read:—

"*On the Production of the Sulphates of the Alcohol Radicles from the Nitrates by the Action of Sulphurous Acid*," by E. T. CHAPMAN.

When sulphurous acid gas is passed into nitrate of amyl it is rapidly absorbed. The nitrate changes in colour from yellow to green, from green to blue; it then begins to effervesce, and at the same time becomes hot and boils violently. Nitric oxide is evolved in abundance, and a yellow liquid product remains. This liquid cannot be distilled without decomposition. It contains no nitrogen. When an attempt is made to distil it along with water, the oily liquid found in the distillate consists principally of amylic alcohol. When the liquid is distilled *per se*, it blackens, gives off sulphurous acid, and yields a complex distillate, which contains, amongst other things, valerianate

of amyl. This circumstance stood in the way of any attempt to obtain an insight into the nature of this reaction. Mr. Chapman resolved, therefore, to attack the question quantitatively. With this object, he determined the nature and amount of the gas evolved, by the action of excess of sulphurous acid on a known weight of the nitrate. The result proved that the gas evolved consisted of pure nitric oxide, and that the whole of the nitrogen present in the nitrite escaped in this form. The amount of sulphurous acid necessary to decompose a given quantity of nitrite, was also determined by observing the quantity of sulphurous acid which disappeared when an excess of sulphurous acid acted on a known quantity of nitrite. It was thus ascertained with sufficient accuracy that one atom of sulphurous acid acted upon two atoms of nitrite of amyl, and liberated two atoms of nitric oxide. Lastly, the alteration of weight which nitrite of amyl undergoes by the reaction was determined. The result confirmed the supposition that the reaction consisted in the replacement of two atoms of nitric oxide by one of sulphurous acid.



The resulting liquid compound had, therefore, the composition of neutral sulphate of amyl. It readily breaks up into amylic alcohol and sulphuric acid by boiling with water, and by long standing even with cold water; treated with strong hydriodic acid it yields sulphuretted hydrogen, water, iodine, and amylic iodide; potassic bichromate and sulphuric acid cause it to yield valerianic acid. It is to be observed that it is necessary gently to warm the retort in which the nitrite is exposed to the action of a stream of dry sulphurous acid; if this is not done, the SO<sub>2</sub> is absorbed for some time without any reaction occurring, but when the reaction does start it is with almost explosive violence, whereas if gentle heating has been applied from the beginning the reaction starts at once and goes on regularly. It is also desirable to pass through the apparatus carbonic acid or hydrogen, before the SO<sub>2</sub> has been passed into the nitrite, and to do this also afterwards for the purpose of excluding air, the oxygen of which would unite with the NO, and the SO<sub>2</sub> would then be expelled.

Sulphurous acid and butylic nitrate react upon one another in a manner analogous to that of SO<sub>2</sub> or amylic nitrite, but the resulting product is even more unstable.

Sulphurous acid and nitrite of ethyl do not readily act upon each other, at least not at the common temperature.

Mr. Chapman then proceeded to the theoretical considerations which are suggested by the above facts. Are these compounds properly speaking sulphates of alcohol radicles, or only isomeric bodies with them? The reaction of the amyl compound with water is very different from that of sulphate of ethyl under similar circumstances; it does not, when boiled with water, form an acid analogous to isethionic acid, but splits up into sulphuric acid and amylic alcohol. This would suggest a different linking of the molecules; most probably in the common amylic sulphate the two organic radicles are linked to oxygen directly, and by oxygen to sulphur; in the amyl compound obtained from the nitrite one of the radicles is attached directly to sulphur, and the other indirectly through the oxygen.

Mr. Chapman then described the apparatus by which the nature of the reaction of sulphurous acid on amylic nitrite has been determined. The evolved nitric oxide was transformed into nitric acid and this treated with barytic carbonate.

In the discussion following this paper, Dr. Debus and Mr. Harcourt expressed their apprehension that along with the barytic nitrate also some barytic nitrite may have been formed. Mr. Chapman replied that he had taken great care to ensure the complete transformation into nitric acid; that to this end he had passed great quantities of oxygen into the collecting cylinder, left the mixture standing for twenty-four hours over the water in



the cylinder, and lastly applied gentle heat to it. As for the possibility of the water acting as a base and reducing the formed nitrous acid, there was the counteracting presence of  $\text{SO}_2$  which had passed unabsorbed through the amylic nitrite into the collecting cylinder, and part of which must have been oxidised to sulphuric acid. Regarding Mr. Chapman's theoretical views of the union of  $\text{SO}_3$  and  $\text{C}_2\text{H}_5\text{O}$ , the President thought that it is the same as that of  $\text{SO}_3$  with  $\text{H}_2\text{O}$ , that the two  $\text{C}_2\text{H}_5$  are linked to  $\text{SO}_3$  by the oxygen just like the two H are in hydric sulphate.

MR. VACHER read a paper by Mr. Elliott, on the "*Determination of Sulphur in Cast-Iron.*"

This determination consists in the liberation of the sulphur in the form of sulphuretted hydrogen, absorption of the latter by solution of soda, and estimation of the  $\text{H}_2\text{S}$  in the acidified soda solution by means of a standard solution of iodine. In the course of his experiments Mr. Elliott noticed that a portion of the iron was not attacked by  $\text{HCl}$ , and that this insoluble residue yielded on fusing with pure caustic soda (prepared from sodium), sodic sulphate. From this Mr. Elliott draws the conclusion that cast-iron contains sulphuric acid as well as sulphur. In somewhat similar manner the presence of phosphoric acid in cast-iron was ascertained.

Dr. DEBUS doubted the probability of the occurrence of sulphuric acid in iron which had once been in a molten state.

Mr. CHURCH remarked that he had noticed by dissolving natural pyrites in  $\text{HCl}$  that very often an insoluble sulphide and phosphide remained. At the same time, he considered the fusion of these residues with caustic alkalies as a sure means of converting the sulphur and the phosphorus into the respective acids, the alkalies being, under such circumstances, very powerful oxidising agents.

Mr. HARCOURT expressed his concurrence with Mr. Church's remarks about the oxidising rôle played in this case by caustic soda.

Mr. VACHER did not wish to support Mr. Elliott's views about the presence of sulphuric acid in cast-iron; but there was the fact of one portion of the sulphur not being liberated by the  $\text{HCl}$ , and this tends to the conclusion that cast-iron contains sulphur in yet another form, as in that of the ordinary sulphide.

"On the Composition of Hyposulphites," by E. A. LETTS.

Though the salts of the hyposulphurous acid have been comparatively well studied, much difference exists as to their chemical constitution. Rose states that an atom of water is retained by all the hyposulphites, and is essential to their composition. On the other hand, Pope and other chemists maintain that most, if not all the hyposulphites, can be obtained in the anhydrous condition. Mr. Letts undertook some experiments to ascertain whether hydrogen was to be regarded as an essential constituent of the hyposulphites. The salts submitted to investigation were those of sodium, barium, lead, strontium, magnesium, nickel, and cobalt. The sodium salt lost all its water readily by drying *in vacuo* over sulphuric acid. The barium salt gives off its water by drying at  $100^\circ\text{C}$ . The plumbic hyposulphite, prepared by adding a solution of lead acetate to one of sodic hyposulphite, crystallises out from the mother liquors without any water at all. This, then, is a case demonstrating beyond doubt that hydrogen is *not* needed to complete the chemical constitution of a hyposulphite. The strontium salt, retained even after drying at  $200^\circ\text{C}$ ., half a molecule of water. The magnesium salt crystallising with six atoms of water loses, by  $100^\circ\text{C}$ ., three of them; but an attempt to expel more water causes the decomposition of this salt. The nickel hyposulphite, the crystals of which have also six  $\text{H}_2\text{O}$ , cannot afford to part with any of it without undergoing decomposition. The cobaltic hyposulphite is even more unstable than the former salt.

The PRESIDENT observed that the contents of the last read paper set at rest the doubts which hitherto existed

as to the constitution of the hyposulphites, and showed that the water which they ordinarily contain, is not essential for their chemical existence.

The Society then adjourned till November 17th.

## CORRESPONDENCE.

### NEW ELECTRO-DYNAMIC LAW.

*To the Editor of the Chemical News.*

SIR,—In the letter you were good enough to publish last week, giving a new electro-dynamic law, by accident the definitions of  $r(w)$ ,  $h(w)$ ,  $R$ , and  $r$  were omitted; namely:—

$r(w)$  = resistance of wire.

$h(w)$  = heat developed in wire.

$R$  = resistance of battery.

$r$  = resistance of rest of circuit.—I am, &c.,

H. HIGHTON, M.A.

Putney, November 5, 1870.

### PRESERVATION OF STONE.

*To the Editor of the Chemical News.*

SIR,—I am really sorry that my friend Mr. Spiller should imagine himself aggrieved by the existence and the success of the "Combined Process" for preserving stone. When he can prove that he was the first to employ solutions of an acid phosphate of calcium, or of an alkaline earth, or of a supersilicated alkaline silicate, separately or successively, for the purpose of preserving stone, I shall be ready to admit his right of complaint. A reference to the report of the Chemical Sub-Committee on the "Decay of the Stone of the New Palace of Westminster," printed in a Blue-Book, August, 1861, will show that phosphoric acid and superphosphate of lime had been proposed previously to that date for the use in question; this was also the case with solutions of the alkaline earths. As to the solution of silica, we owe that, Sir, to your suggestion; but unmixed with an alkaline silicate, I have failed to make it penetrate any stone containing much calcareous matter.

On the whole, then, I argue that Mr. Spiller cannot claim novelty of application with respect to either of the solutions he is said to use, and that I had as good a right to adopt them as he had. But if Mr. Spiller really employs (see his letter in this week's CHEMICAL NEWS) a solution of "superphosphate of lime *mixed* with a little baryta," I admit at once the complete novelty of such a preparation.

I should, however, much like to know how he prevents these "*incompatibles*" from precipitating one another. It would be very interesting to see mono-calcic phosphate and barium hydrate co-existing in Mr. Spiller's solution.—I am, &c.,

A. H. CHURCH.

Royal Agricultural College, Cirencester,  
November 5th, 1870.

## MISCELLANEOUS.

University of London.—The following are lists of the candidates who have passed the second B.Sc. examination:—*First Division.*—John Ambrose Fleming, University College; Thomas Hick, B.A., private study. *Second Division.*—Edward Bibbins Aveling, University College; Frank Clowes, College of Chemistry and private study; William Turner Thistleton Dyer, private study; John Anderson Hartley, B.A., University College and private



study; Henry Newell Martin, First M.B., Christ's College, Cambridge, and University College, London; Thomas Firth Moorhouse, private study; Robert Davies Roberts, University College; Robert Routledge, Owen's College; Frank Salter, University College.

**Phosphate of Lime as a Mordant.**—Dr. Reimann.—A rather thick syrupy solution of phosphate of lime (bone-ash) in hydrochloric acid having been recently recommended as a mordant to be used after a previous sumacking of the goods, the author states that, according to his researches, the phosphate of lime solution is altogether superfluous, since a sumacking with 4 lbs. of sumac to 20 lbs. of cotton is of itself a sufficient mordanting to fix aniline colours excellently. The application of the phosphate of lime solution as a mordant for cochineal colours upon cotton the author also considers as quite useless.

**Solution of Water Glass.**—Dr. Flückiger.—This solution is precipitated by a solution of nitrate of soda, and the following curious phenomenon is exhibited; when a solution of silicate of soda of 1.392 sp. gr. is precipitated with a solution of one part of nitrate of soda in one of water the silica is immediately separated, but if the nitrate is dissolved into two parts of water, and if equal parts of both liquids are mixed, no precipitate ensues until the mixture is heated to 54°, when silica separates in a gelatinous state so as to cause nearly the solidification of the mass. If this experiment is made in a small flask and the vessel suddenly cooled again, either to the ordinary temperature or even below 0°, the silica is suddenly dissolved again; this experiment may be repeated any number of times.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

*Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

**NOTE.** All degrees of temperature are Centigrade, unless otherwise expressed.

*Sitzungsberichte der Königlich Bayerische Akademie der Wissenschaften zu München, Vol. i., No. 1, 1870.*

This number contains the following original papers and memoirs relating to physico-chemical and allied sciences:—

**Comparator for the Indication of the Toise and the Meter, and also for the Determination of the Absolute Longitudinal Expansion of Rods.**—Dr. von Steinheil.—This paper, illustrated by engravings, contains the description of an instrument (comparator) devised by the author for detecting the absolute longitudinal expansion of metallic rods employed for the construction of measures of length.

**Changes which the Colours of some Blossoms and Flowers Undergo when Exposed to Ammonia Gas.**—Dr. Vogel.—The author relates, at great length, a series of experiments extended over no less than eighty-six species and varieties of flowers, and made with the view to learn how the colours thereof are affected by the action of ammonia gas, the flowers being exposed to that gas by being placed under a bell-jar filled with the gas, and left in that condition for from a quarter of an hour to two, or even twelve, hours. Among the general results obtained by the author, we notice that he found marked difference to exist between the action of the gas upon flowers, the colouring matter of which is fixed in small granules, and that which is present in solution; the former is far less changed than the latter. Among the eighty-six kinds submitted to research, twelve exhibited no change whatever; of these, seven were yellow, and five deep violet-coloured. Deep violet-coloured flowers are not at all affected, and some blue colours also stand the action of the gas for a time very well. The alteration produced by the gas is, in most cases, very akin to that called forth by the fading away of the flowers. The yellow colouring matter of the *Lotus corniculatus* exhibits a great stability, since it withstands the action of ammonia gas for twelve hours without change. On becoming dry, this colouring matter becomes bright green.

**Quantity of Water Evaporated by an Oak-Tree during the entire period of its Growth.**—F. Pfaff.—This lengthy treatise con-

tains the results of photo-physiological experiments made with the view to ascertain the quantity of water evaporated during the entire period of vegetation of an oak-tree, as deduced from very minutely and accurately executed experiments, and in order to illustrate the effects of trees and forests as affecting the rainfall. The essay is accompanied by lengthy tabulated forms containing a series of figures.

**On Rabdionite, a New Mineral Species, and on an Asbolan which contains Lithia.**—F. von Kobell.—Rabdionite is a mineral exhibiting a dull black colour; it becomes metallic-like when rubbed; is very soft; its powder is deep brown-coloured. The sp. gr. of the mineral is 2.85; it fuses in the blowpipe flame, yielding a steel-blue coloured globule which acts upon the magnetic needle (the mineral does not do so before being fused). On being heated in a small flask or test-tube, water is given off. The mineral is readily soluble in hydrochloric acid, chlorine being evolved, but hardly soluble in nitric acid. Analysis, in 100 parts, gave—Peroxide of iron, 45.00; peroxide of manganese, 13.0; alumina, 1.40; oxide of copper, 1.40; protoxide of manganese, 7.61; oxide of cobalt, 5.10; water, 13.5;—total, 99.61. The name rabdionite is derived from the greek word *rabdion*, a small rod, because the mineral occurs in a shape resembling this. The mineral was obtained from the Nischne-Tagilsk mines, on the Ural (Russia). The author briefly mentions some researches instituted by him with a mineral which was stated to be asbolan, but differs in composition from a mineral of the same name analysed by Dr. Rammelsberg, inasmuch as the mineral investigated by the author contained lithia in very small quantity, however, and, besides, 54 per cent of peroxide of manganese, 4 of oxide of cobalt, 0.61 of oxide of copper, 13.4 of water, and 23 per cent of alumina.

Vol. I., No. 2, 1870.

This number contains the following original papers and memoirs relating to physico-chemical sciences:—

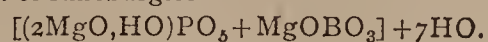
**Researches on Electrical Discharge.**—Dr. W. von Bezold.—This paper has been given in an enlarged and more complete form in another periodical, from which we have briefly abstracted it (see CHEMICAL NEWS, vol. xxii., p. 227).

**On the Riesvulkan, and on Volcanic Phenomena in the Ries-kessel.**—Prof. Gümbel.—This lengthy memoir contains the detailed account of a geognostic and mineralogical investigation of a mountain belonging to the Swabian Jura chain.

Vol. i., No. 3, 1870.

This number contains the following original papers relating to chemistry and collateral sciences:—

**On Lüneburgite.**—C. Nöllner.—The author states that, a boring having been made with the view to reach deposits of salt in the neighbourhood of Harburg (Prussia), a new mineral was found, to which the name lüneburgite was given. The composition of that mineral, in 100 parts, is—Magnesia, 16.75; water, 3.78; phosphoric acid, 29.83—this portion forming a separate salt, but combined in nature with the following constituents:—Magnesia, 8.35; boracic acid, 14.72; water, 26.17. Formula of lüneburgite—



**On Gümbellite.**—Dr. von Kobell.—The substance alluded to is a new mineral, named after its discoverer, M. Gümbel. The mineral occurs in thin layers on thouschiefer. The colour is whitish green; melts before blowpipe-flame with some difficulty, forming a porcelain-like mass. Heated in a flask or test-tube, water is given off; insoluble in hydrochloric and sulphuric acids. It consists, in 100 parts, of—Silica, 50.52; alumina, 31.04; peroxide of iron, 3.0; magnesia, 1.88; potassa, 3.18; water, 7.0; matter undecomposable by fluorhydric acid, 1.46;—total, 98.08.

Vol. I., No. 4, 1870.

The following original papers relating to chemistry and collateral sciences are found in this number:—

**Luminosity of the Water Hammer.**—Prof. Lommel.—This memoir contains the account of a series of experiments made with the view to ascertain whether the instrument known as the water hammer (in this instance constructed of glass tubes of from 15 to 23 centimetres' length, by from 10 to 15 millimetres' width, and provided on one end with a bulb of about 4 centimetres' diameter, the tube being partly filled with pure water freed from air by long-continued boiling) would, when electrified as Geissler's tubes, produce phenomena similar to the latter when electrified. The author found that the water hammer acts in a very similar manner as do the Leyden jars, which are connected with the conductors of electric machines (*influenzmaschine*) for the purpose of obtaining stronger sparks; moreover, the tubes alluded to exhibited brilliant luminous phenomena.

Vol. II., No. 1, 1870.

This number contains the following papers relating to physico-chemical sciences:—

**Crystal Water.**—Dr. F. von Kobell.—This very lengthy treatise sets forth the following facts:—Water of crystallisation is an absolute requisite necessary to the very existence of a chemical species. This water therefore belongs to the true chemical constitution of a body, and is not an appendix to its physical properties, as is the case with hygroscopic water. When the water necessary for the existence of any compound is termed water of constitution, all water of crystallisation has to be so named, because it is absolutely necessary to form the specific compound, which is altered and changed in its character as soon as the water is eliminated.



*Annalen der Physik und Chemie, von Poggendorff, No. 9, 1870.*

This number contains the following original papers:—

**Calorimetric Researches.**—R. Bunsen.—This lengthy memoir, illustrated by engravings, is divided into the following sections:—The ice calorimeter; estimation of specific heats. The contents of this memoir more strictly belong to the domain of algebraical than experimental natural philosophy. The paper abounds with formulæ and tabulated results.

**Relation Existing between the Crystalline Form of Bodies and the Chemical Constitution of some Organic Compounds.**—P. Groth.—The author states that his object in writing this paper has chiefly been the investigation of the relation which exists between the crystalline form of a chemical compound, and the change that form undergoes when, for one or more of the hydrogen atoms of the compound, are substituted other groups of atoms. The author illustrates this by several instances—as, for instance, benzol,  $C_6H_6$ , which crystallises in the rhombic shape, while its first hydroxyl-derivative, phenol, assumes the same shape. The contents of the paper are, however, purely crystallographical, and, therefore, not suited for further abstraction.

**Experimental and Theoretical Researches on the Equilibrium Figures Exhibited by a Fluid Mass not endowed with Gravity.**—J. Plateau.—Eighth paper on this subject.

**Absorption of Light.**—P. Glan.—A mathematico-physical essay illustrated with engravings.

**Appendix to a Paper on "Researches concerning the Behaviour of Vapours as regards the Laws of Mariotte and Gay Lussac."**—Dr. H. Herwig.—This paper is chiefly a collection of tabulated results of experiments.

**Analogy Existing between some of the Principal Axioms of Photometry and the Doctrine of Attraction.**—W. Bezold.—An algebraical essay.

**Luminosity of Phosphorus.**—W. Müller.—The contents of this paper are an extended report of the author's experiments on this subject, already quoted, in its essential details, from another periodical (see CHEMICAL NEWS, vol. xxi., p. 190).

**Peroxides of Metals which can be Obtained by Electrolysis.**—W. Wernicke.—This lengthy essay treats on lead, manganese, bismuth, cobalt, and nickel. The author's results of experiments may be summarised as follows:—The peroxides of metals separated from alkaline or neutral solutions by means of electrolysis are hydrates, composed according to the formulæ  $RO, H_2O$  or  $R_2O_3, 2H_2O$ . The composition and specific gravity of the substances investigated are—Hydrated peroxide of lead,  $PbO_2, H_2O = 6.267$ ; hydrated peroxide of manganese,  $MnO_2, H_2O = 2.564-2.596$ ; hydrated peroxide of bismuth,  $BiO_2, H_2O = 5.571$ ; hydrated peroxide of cobalt,  $Co_2O_3, 2H_2O = 2.483$ ; hydrated peroxide of nickel,  $Ni_2O_3, 2H_2O = 2.744$ . These substances exhibit, in thin layers, most magnificent interference colours; and, for the technical purposes of metallo-chromy, the colours exhibited by the hydrated peroxide of cobalt will be valuable, on account of being readily prepared and permanent. The compounds alluded to were only produced by very weak electric currents; stronger currents produce other compounds containing less oxygen.

**Mechanical Law Applicable to Calorics.**—R. Clausius.—An algebraical essay.

**Spectra Exhibited by Negative Electrodes and by Geissler Tubes which have been Used for a Long Period of Time.**—Dr. E. Reitlinger and M. Kuhn.—An extensive and concisely-written essay, not suited for any useful abstraction.

**Changes Produced in the Brown Coal (Lignite) of the Meissner by Coming into Contact with Basalt.**—Dr. A. von Lasaulx.—The locality designated as the Meissner is a mountain situated in the Prussian province of Hesse. The paper is chiefly written with the view to prove that the changes which the lignite has undergone by coming into contact with basalt does not prove the igneous origin of the latter. The paper contains several analyses, among which are the following (all substances dried at  $100^\circ$ ):—Anthracite (sp. gr., 1.412).—In 100 parts: Carbon, 80.40; hydrogen, 3.30; sulphur, oxygen, and nitrogen, together, 5.67; bituminous matter, 0.73; ash, 9.90;—total, 100.0. A material named *stangen kohle*, that is, a coaly matter in the shape of rods (sp. gr., 1.397).—In 100 parts: Carbon, 78.14; hydrogen, 3.73; sulphur, oxygen, and nitrogen, together, 4.03; bituminous matter, 0.83; ash, 13.27;—total, 100.0. Deep black-coloured coaly matter (sp. gr., 1.286).—In 100 parts: Carbon, 62.20; hydrogen, 5.28; sulphur, oxygen, and nitrogen, together, 22.75; ash, 9.77;—total, 100.0 (bituminous matter in this coal was 1.5 per cent, and it was found to be partly soluble in caustic potassa, which is not the case with the other two samples). Compact brownish black-coloured lignite (sp. gr., 1.201).—In 100 parts: Carbon, 59.92; hydrogen, 5.66; sulphur, nitrogen, and oxygen, 26.12; ash, 8.30;—total, 100.0 (contains a large proportion of bituminous matter, and is in a great measure soluble in caustic potassa solution). In order to investigate the effect which a fused mass, as basalt has sometimes been supposed to be, would have upon this lignite, a considerable quantity was exposed to the action of molten blast-furnace slags, and the pieces so exposed analysed, the result being (sp. gr., 1.363), in 100 parts—Carbon, 80.36; hydrogen, 3.04; sulphur, nitrogen, and oxygen, 1.20; ash, 15.40. The lignite was exposed to the action of the slags in fire-clay crucibles and under a cover of fire-clay.

**Analysis of Silicates.**—E. Ludwig.—This paper treats on the analysis of a felspar from Närke (Norway), which, having been analysed by the author, as well as by Dr. G. von Rath and Professor C. Rammelsberg, yielded, to each, results which exhibit rather great discrepancies in the quantity of silica and alumina obtained by these authors, varying, for silica, from 51.78 to 48.94 per cent, and for alumina

from 33.36 to 30.77 per cent. The author's paper is a lengthy essay on the different methods in use for estimating silica and alumina when present in complex minerals, but, unfortunately, the bulk of the essay consists of quotations of results of test analyses, and is, therefore, not well suited for further quotation.

**Absorption-Spectrum of Fluid Hyponitric Acid.**—A. Kundt.

**Observations on Dr. Boltzmann's Paper "On the Force Exerted by Moving Masses of a Gas."**—Dr. Kurz.

*Polytechnisches Journal von Dingler*, first number for October, 1870.

This number contains the following original papers relating to chemistry and allied sciences:—

**The Tallow-Melting Industry.**—Dr. H. Vohl.—This paper, illustrated by engravings, treats on the best methods to prevent the complaints, often, and not unreasonably, made, about the smell and nuisance arising from the melting of tallow. The author describes at length a contrivance whereby the melting of tallow may be conducted without giving rise to any complaints. Unless we were to reproduce the engraving, absolutely required to understand the arrangement, we could not enter into further details on this subject.

**Description of the Adalbert Ironworks at Kladno (Bohemia).**—J. Zeman.—This paper, illustrated by several engravings, is the first portion of a detailed description of an ironwork which, however interesting it may be for the Continent, is surpassed, in extent and perfection of arrangement, by several similar works in the United Kingdom.

**Desilvering Lead by means of Zinc.**—C. M. Balling.—A lengthy treatise, illustrated by several engravings, containing a detailed account of the process alluded to as practically executed in different countries.

## NOTES AND QUERIES.

**Estimating Tartaric and Citric Acids.**—(Reply to A. J. M. Edger).—You will find the information you require, too lengthy to be here printed, in Richardson and Watts's "Chemical Technology," vol. i., part 5, pp. 168 and following and 178 and following.

**Manufacture of Anthracene.**—I have been requested to enquire whether there is in England anyone manufacturing anthracene out of raw petroleum or the residue of petroleum distillation. I understand that anthracene is usually made from asphaltum both in England and abroad, but that the other process, mentioned above, has been introduced for some time.—J. BERNAYS.

**Decolourising Property of Animal Charcoal.**—Will any correspondent be good enough to inform me where the best explanation that has yet been given of the peculiar decolourising and other properties of animal charcoal is to be found. The accepted theory in all the works I have consulted appears to be that the action is purely mechanical, and due to the surface of the numerous pores. The doubt expressed by most of the authors, induces me to ask this question.—A STUDENT.

**Phosphate of Lime.**—(Reply to W. Tate.)—On referring to Gmelin's "Chemistry," translated by Watts, you will find the equivalent of  $3CaO, cPO_5$  given as 155.4, while  $cPO_5$  is there stated to be 71.4. At page 192 and following of vol. iii. of the work alluded to, you will find the theory of Berzelius alluded to based upon his experiments as regards the salt; the equivalent of  $2CaO, PO_5$  is stated to be 127.4, and the equivalent of  $2CaO, PO_5, 4HO = 163.4$ . In commercial analyses, the figures quoted by you are usually taken as the equivalent of triphosphate.

**Dyeing Queries.**—Can any of your readers kindly give me a little information on the following subject:—I have a friend who is manufacturing cloths of enclosed kind, and he has set up a steam-box of his own, so as to tip or print his own; and I have a small works of my own, where I make extract of logwood, &c.; and I wish you to give me a formula for a good black colour, and one for a dark claret (or chocolate, as some call it)—but I want the colours to be of a good lustre after being steamed; and for full depth of colour the fine pieces are tipped with a brush, then put into a large steam-box for an hour at a pressure of 12 lbs. to the square inch; they are then taken out, all the colour washed out, and dried. Many of them are done twice over.—A. SYKES.

## MEETINGS FOR THE WEEK.

MONDAY, 14th.—London Institution, 4. Dr. Odling, F.R.S., "On Chemical Action."

TUESDAY, 15th.—Geographical, 8.30.

THURSDAY, 17th.—London Institution, 7.30. Dr. W. H. Stone, M.A., F.R.C.P., "On the Acoustics of the Orchestra; Wind Instruments."

Chemical, 8. Prof. N. Story Maskelyne and Dr. Walter Flight, "Mineralogical Notices."

## TO CORRESPONDENTS.

A. Whitelaw.—We regret that the report of the meeting arrived too late for insertion this week.

J. Bowling.—The query is inserted with pleasure.

F. M. Jennings.—Received with thanks. The Hungarian opals will be carefully examined. They are good specimens.



# THE CHEMICAL NEWS.

VOL. XXII. No. 573.

## EVIDENCE CONCERNING THE GERM THEORY OF FERMENTATION AFFORDED BY THE ACTION OF CERTAIN SUBSTANCES WHEN SUSPENDED IN THE AIR.

By ARTHUR ERNEST SANSOM, M.D.

IN the controversy respecting the origin of life, which has recently occupied much of the time of scientific men, and has called forth much warmth of advocacy on either side, great stress has been laid upon the evidence afforded by the action of heat as a means of destroying vital manifestations. It has been urged as impossible that any living matter can, after subjection to a temperature of more than 307° F., continue to manifest any signs of vitality. Some objectors have demurred to the conclusion that *all* the possible particles in the fluids employed were by the conditions subject to this high temperature; others, while accepting the premisses, have objected to the conclusion. It is well known that living matter has powers of persistence and resistance which no *primâ facie* considerations would suggest.

It is admitted that living matter can be exposed to sudden extremes, from freezing to boiling, without losing the germinating faculty.\* It can scarcely be wondered at, therefore, that some persons hesitate to adopt the alternative conclusion that living things can be generated "spontaneously"—i.e., from dead matter and ordinary physical forces. It may, at least, be urged that the conclusions obtained from the evidence of heat should be tested by the results of the employment of other agents of vital destruction.

In the late controversy, such influences seem to have been ignored; but, among these, many useful lessons may be learnt by a consideration of the destructive influences of chemical and of poisonous agents. It was known, from very early ages, that certain substances added to matters undergoing fermentation or putrefaction† put a stop to these processes. The process of embalming, for the prevention of putrefaction of the human body, is an example which dates from the greatest antiquity. Emanations from putrid material have been always looked on as sources of danger to health, and various applications have been made to putrefying materials with the object of arresting putrefaction. Sir John Pringle and Dr. Macbride, in the last century, classified such substances as arrested putrid emanations under the title of Antiseptics; these observers, moreover, performed many experiments with regard to them, and endeavoured to ascertain their relative values. There have been various theories advanced to account for the mode of operation of these various bodies in restraining putrefactive changes, and usually their action has been considered, in some sort, a chemical one—they either oxidise, deoxidise, or chemically unite with the putrescible material. But we should imagine, if a chemical agent arrested putrefaction or fermentation in virtue of its chemical powers, there should

be some sort of quantitative relation between its potential activity and the constituents of the substance itself. At least, we should imagine that, in the one case, it should be present in sufficient proportion to produce some appreciable chemical change upon the bulk of the nitrogenous substance, in the case of putrefaction, or the ferment or the fermentescible substance in the case of fermentation. But the facts are, that substances present in such feeble amounts as to be incapable of any manifest action upon the organic material, are, nevertheless, competent to arrest all the phenomena of putrefactive or fermentive decomposition.

Let us turn to the theory which proposes to explain the phenomena, on the supposition that they are produced by the acts of life of organised particles.

We see, by very obvious data, that there is an analogy which cannot fail to be remarked between the phenomena of the two processes and the conditions which we know to be favourable to vital organisms—air, light, warmth, moisture—these are the conditions most favourable to the changes. Conversely, circumstances antagonistic to life are unfavourable to the changes; such are an excess of heat or a very low temperature, dryness, physical injury (trituration yeast in a mortar spoils it for effecting fermentation). Gases which do not support life stop the phenomena of putrefaction and fermentation: such are hydrogen, nitrogen, carbonic acid. Furthermore, not only there is a definite relation between the stage of growth of the yeast fungus and its power of exciting fermentation, but, in the words of Professor Miller, "everything that destroys the vitality of these organised bodies destroys their power of exciting fermentation."

Also, with regard to mildew formation. As M. Béchamp showed, whilst mildew was developed on every occasion when air acted on putrescible material, and no substance fatal to organisms was present, no mildew was observed when any substance which killed germs was present. But here Professor Hallier steps in and shows that many saline solutions which might, *à priori*, be deemed likely to exert toxic influences nevertheless—some to great extent others slightly—permit the growth and development of fungi. Acetic acid, when dilute, permits growth, and its salts afford admirable pabula for penicillium growths. The same is true of oxalic acid and the oxalates. Vegetating fibres are also found in the alkaline and earthy chlorides, and in boiled sea-water. The phosphates, also, are very favourable for vegetation. Tannin is a good pabulum; and cyanides readily permit growth. The mineral acids, only when very dilute, permit any vegetation; but their salts often allow growth of penicillium, &c.

On the other hand, alcohol, benzol, and carbolic acid are powerful poisons to fermentation-cells and mildew formations.

Carbolic acid acts *solely* by killing the organised bodies which are the intermediate agents between organic material on the one hand, and the inorganic ultimate products of decomposition on the other. What bearing does this conclusion have on the controversy concerning the origin of life? While it puts aside all notions of intermediate chemical changes as favouring the spontaneous evolution of organisms, the objection may yet hold that the *initial* changes may yet be heterogenic, though the carbolic acid exerts its toxic power when once a molecule has acquired vitality. To obtain some evidence on this question as well as to endeavour to fix the action of carbolic acid in its relation with other media, the following experiments have been performed by the author:—

*Expt. 1.*—Freshly made maceration of lean beef was kept in bottles, A, in contact with ordinary air; B, in air containing the vapour of carbolic acid. A showed usual signs of putrefaction; at the end of twelve days was of extreme foetor, and presented upon its surface a dense film which, when examined by the microscope, disclosed myriads of microscopic organisms. B in its whole extent was clear and transparent, and possessed no odour save that of carbolic acid; the film instead of being made up

\* "Les infiniment petits possèdent donc, pour la plupart, une résistance souvent surprenante au chaud et au froid. Une expérience de M. Pouchet montre même que certains d'entre eux peuvent supporter facilement des brusques changements de température, franchir un intervalle de plus de 100 degrés!"—*Pennetier, Origine de la Vie.*

† It should be premised that there are two theories concerning the nature of fermentation and putrefaction. According to the one, these processes are essentially chemical, and are the results of the actions of nitrogenous organic bodies undergoing molecular (catalytic) changes. According to the other, they are due to the acts of life of vitalised (fungoid) particles. For a statement of the arguments, the reader is referred to a paper which will appear in the next number of the *Quarterly Journal of Science.*



of a congeries of minute organisms, was a basis structure of an exceedingly delicate and perfectly transparent membrane. It entangled here and there a few aggregations of monads.

In this case no effort was made to destroy any possible germ in the meat infusion; only in one case the air contained a poisonous agent, and here a marked repression was exerted upon the appearance of forms of life and upon the process of putrefaction.

(To be continued).

## EXPERIMENTS UPON SUPERSATURATED SOLUTIONS OF SODIC SULPHATE.

By ARCHIBALD LIVERSIDGE,  
Associate of the Royal School of Mines.

### *Review of Theories.*

BEFORE drawing attention to the results furnished by my own experiments, it will, perhaps, not be out of place to pass in review the various theories which have been put forth in explanation of the action of nuclei upon supersaturated saline solutions. This I do because my experiments are supported by some and not by others of these theories. In 1809, Ziz, of Mayence,\* came to the conclusion that a crystal of sodic sulphate was the best nucleus for a supersaturated solution of that salt.

Gay Lussac, in 1819, was of opinion that the sudden crystallisation of a supersaturated solution was due to a purely mechanical force, such as the agitation of the liquid within the containing vessel.† “La cause générale qui produit la sursaturation étant évidemment la même pour chaque sel, il suffira d’observer cet effet dans ceux où ils se montrent avec la plus d’intensité . . . . On ne peut assigner le terme auquel la sursaturation s’arrête : ce terme, dans chaque expérience est tout-à-fait accidentel, il dépend de la nature du vase, de son poli, de sa propriété conductrice, de l’agitation de l’air. . . . Or, puis qu’on détermine la cristallisation dans cette dissolution sur-saturée de carbonate de soude par une légère agitation il faut que la sursaturation dépende non de l’affinité, mais d’une force purement mécanique ; car le mouvement ne peut par lui-même produire des effets chimiques.”

Löwell,‡ in 1850, referred the phenomena exhibited by supersaturated solutions to some mysterious catalytic action of the air and other bodies.

In 1851, M. Goskynski|| propounded the theory “that the upper layer of the liquid lost water by evaporation,” by this means small crystals were set free, which formed centres of attraction from which crystallisation was propagated throughout the mass of the solution.

Gernez, in 1865, was convinced that nuclei acting upon solutions of sodic sulphate, consisted of particles of that salt which were disseminated throughout the atmosphere.

And respecting the presence of this salt in the air, he says:— “La présence de cette substance dans l’air n’a du reste rien d’extraordinaire, si l’on remarque que l’acide sulfureux et l’hydrogène sulfuré produit dans l’atmosphère se transforment facilement en acide sulfurique, et que le sel marin, provenant de l’eau de la mer, doit donner avec cet acide du sulfate de soude.§

In a later paper¶ he states that supersaturated solutions of alum, plumbic acetate, zincic sulphate, sodic hyposulphite, &c., can be kept fluid in open flasks for a longer time than sodic sulphate, on account of the less uniform diffusion of particles of those salts in the air.

M. Violette also arrived at about the same results, independently of Gernez.\* He states that the activity of the nucleus is destroyed on exposure to a temperature of 33.5 or 34° C., it is dissolved or modified by water, Cl, Br, most gases, alcohol, ether, &c. He says that the air at all places and under all conditions does not equally contain these crystalline particles, just as M. Pasteur has shown is the case with organic germs. In some places the particles which provoke crystallisation are, at times, altogether absent.

M. Jeannel (*Comptes Rendus*, lxi., p. 412), attributed the crystallisation of supersaturated solutions to purely physical causes, and not to the action of a particle of the same salt.

M. Dubrunfaut† thought that the formation of the salt containing ten atoms of water was directly determined by the presence of such a crystal acting as a nucleus.

M. Lecoq de Boisdaudran‡ also experimented and wrote upon the phenomena presented by supersaturated saline solutions; he attributed nuclear properties to both the crystals of the normal sodic sulphate and to its isomorphs.

In 1868 a paper was communicated to the Royal Society, by Mr. Tomlinson, to show that the effects, attributed by earlier observers to various causes, depended solely upon want of chemical cleanness in the body which acted as a nucleus.

In this and subsequent papers the following definitions were given:—

“A nucleus is a body that has a stronger attraction for the gas, or the vapour, or the salt of a supersaturated solution than for the liquid that holds it in solution.”

“Nuclei with certain limitations cease to be such when made chemically clean. A body is chemically clean the surface of which is entirely free from any substance foreign to its composition. Thus, oils and fatty bodies are chemically clean if chemically pure.”

The limitations above referred to are two. “(1) Oils, fats, &c., when chemically clean, do not act as nuclei when in the mass, such as a lens or globule, but these oils, &c., whether clean or not, act powerfully as nuclei when in the form of thin films.” The second limitation is connected with solutions of gases with which we have nothing to do here.||

Again, “an active or non-catharised surface is one contaminated with a film of foreign matter, the filmy condition appearing to be necessary to secure that close adhesion which brings about the nuclear action.”§

From the foregoing it appears that, in the main, three theories have been offered with respect to the action of upon supersaturated saline solutions.

I. That the crystallisation of a supersaturated solution is due to the entrance of a particle of the same salt.

II. That the crystallisation set up in such solutions is due to some unknown catalytic force.

III. Nuclei are fatty, oily, greasy, or other matters, in the state of thin films.

I will now proceed with the results furnished by my own experiments. It may not, perhaps, be superfluous for me to first give the method used in preparing the supersaturated solution of the salt.

### *Preparation of the Solution.*

The re-crystallised sodic sulphate of commerce was dissolved in tap water; filtration was unnecessary, the salt as used being free from dirt; in some cases the solution was prepared in separate 2 oz. flasks or a greater quantity was dissolved in a large vessel, and then divided out into smaller flasks, each of which was then boiled up, previous to being set aside on a marble slab to cool

\* Schweigger, *Journal für Chemie und Physik*, xv. For several of my references I am indebted to Mr. Tomlinson’s paper in the *Phil. Trans.*, for 1868.

† *Ann. de Chimie et de Physique*, 2nd series, vol. xi, p. 303.

‡ *Ann. de Chimie et de Ph.*, 1850—1857.

§ *Ibid.*, vol. xxxvii., p. 156.

¶ *Comptes Rendus*, vol. lx., p. 833.

|| *Ibid.*, vol. lxi., p. 849.

\* *Comptes Rendus*, vol. lx., pp. 831 and 971; also *Memoir de la Société de Sciences de Lille*, 1860, 2nd series, vol. vii.; *Revue des Sociétés Savantes*, March 27, 1863.

† *Comptes Rendus*, April 19th, 1869.

‡ *Ann. de Ch. et de Ph.*, 4th series, No. xviii.

§ *Proc. Royal Society*, No. 108, 1869; and *CHEMICAL NEWS*, August 19th, 1870.

¶ *CHEMICAL NEWS*, August 26th, 1870, p. 98.



during the night. An excess of salt was always used so as to ensure perfect supersaturation, the quantity in excess being left at the bottom of the flask or thrown down, on boiling the solution, in the form of the analogous salt. While still boiling the flask was either plugged with cotton wool, or covered with a watch-glass, as suggested by Mr. Löwell, or preferably a small beaker was used as a cover.

A great drawback to the employment of cotton wool is that filaments of it adhere to the neck of the flask, and these, on inserting a body, such as a rod or crystal, get carried down at the same time, when they cause the solution to crystallise, and thus vitiate the experiment.

The proper preparation of the solution is, of course, a point of fundamental importance, therefore I again repeat that in every case, when the substance under trial did not act as a nucleus, before accepting the results of an experiment I was careful to prove the supersaturation of each individual solution by means of a dirty rod or other body; for, as Mr. Tomlinson has remarked, a solution which is supersaturated at a given temperature, may be merely saturated at a higher.

#### *Are Nuclei Rendered Inactive by Washing in Water?*

Ziz, Gernez, and Violette say yes, but Mr. Tomlinson has lately pointed out\* that although wet nuclei often do not, yet occasionally they do, act after some time, it may be several hours. Since the publication of this I have repeated many of my experiments upon them,† and am glad to say that they confirm Mr. Tomlinson's experience.

#### *Experiments made with Thin Films.*

It has been already stated that I did not find thin films active as nuclei,‡ and, in support of that statement, I subjoin the following series of experiments:—

*Expt.*—A glass rod was purposely made greasy, and exposed for a short time to the flame of a spirit-lamp, but not long enough to burn off all the greasy film. After cooling, it was placed in a supersaturated solution of sodid sulphate, and was allowed to remain in for some hours, but it did not set up crystallisation. On withdrawal from the flask the rod was washed with clean cold water, when its surface was shown to be still greasy by the manner in which the water ran off in places and collected into beads in others. After washing the rod in caustic alkali, the water wetted its surface uniformly.

This experiment was repeated many times and with the like results in each instance.

*Expt.*—The interior of a flask was made greasy, the solution boiled up in it and then allowed to cool. No effect.

When cold the inside was shown to be still greasy by the non-adhesion of the solution to the surface of the flask. A cold supersaturated solution wets a clean glass surface uniformly in the same way as water.

As a proof that the finger of itself becomes unclean and generates a nuclear action, Mr. Tomlinson cites an experiment made with rotating camphor particles (see CHEMICAL NEWS, September 2nd, p. 110), with a view to determine, "how long the finger, being made chemically clean, would remain so. The finger was first thoroughly washed in a solution of soap, then in alcohol, and lastly under a stream of water, and so dipped into water, on the surface of which camphor fragments were briskly spinning. The finger was retained under the surface of the water, and slid along about an inch in length of the surface of the glass below the water. In less than two minutes the camphor fragments were brought to rest, and they did not recover their activity."

I readily admit that this secretion of the finger may render the surface of the water unclean, and that this uncleanness may arrest the motion of camphor particles, but

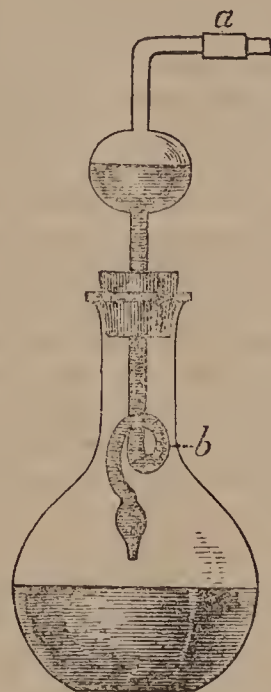
I do not clearly see that because this secretion is effectual in arresting this motion, that it should also determine the crystallisation of a supersaturated solution of sodid sulphate. In the case of camphor the film may act by arresting the evaporation both from the surface of the water and from the camphor, for the latter in its movements would pick up a coating of oily matter, through which evaporation might not readily take place.

The next experiment was made in order to ascertain if the greasy film generated by the finger did become nuclear after some time.

*Expt.*—The finger was, first of all, made slightly greasy, then imperfectly wiped with a duster; it was now passed several times through the flame of a spirit-lamp, and finally inserted into a flask of solution; the flask was chosen with a neck of such a size that, when the last joint of the finger entered the liquid, the opening was completely stopped by the thicker part of the finger.

The flask was placed in water artificially reduced to a temperature of 40° F., and there kept for 10, 20, 30, and 35 minutes at a time, when the finger was withdrawn without crystallisation having taken place.

That the finger had not lost its film of grease was shown by the solution running off the nail every time it was



raised from the liquid, neither did the solution solidify when made to touch those parts of the flask upon which the finger had been pressed.

This experiment was repeated twelve times, and in every instance was the filmy matter of the finger inactive.

As it is sometimes found rather difficult to obtain iridescent films upon the surface of the supersaturated solution, the expedient of dissolving the oils and fatty bodies in ether was made use of. By this means a very small quantity of the fatty substance under trial was caused to cover a large area, for as the ether evaporated an excessively thin film of the less or non-volatile matter, as the case might be, remained behind upon the surface of the solution.

In order to permit the oil, fatty, or other body being conveyed to the solution without access of nuclei from extraneous sources, the contrivance figured above was employed, and the manipulation was as follows:—

The knot, *b*, was first rendered inactive by heating it in the lamp flame, the bulb was warmed, then the tube was inserted into the bottle containing the ethereal solution of oil, or other fluid; then as the air in the bulb cooled a small quantity was sucked up; this was then boiled both in the bulb and in the knot so as to destroy any nuclei which might be adhering to the bulb-tube or be contained by the fluid under trial; usually during the boiling the liquid inflamed and burnt at the aperture of the knot, but this offered no difficulty since the flame could always be blown out with ease. The beaker or watch-glass was then quickly and quietly

\* CHEMICAL NEWS, September 2nd, p. 109 (1870).

† *Ibid.*, August 19th, 1870, p. 91.

‡ *Ibid.*, August 26th, p. 97.



removed from the mouth of the flask with one hand, and the bulb-tube inserted into the neck of the flask with the other; five or more minutes were then allowed for the deposition of any dust which might have entered during the uncovering; if at the end of this time the super-saturated solution still remained fluid, a drop of the liquid was expelled from the bulb-tube, either by warming the bulb with the fingers or by loosening the stopper, *a*. The ethereal solution generally flattened out by the fall; if not, it was readily made to do so by a quick twist of the flask; the ether speedily evaporated, and left the oil, or fatty body, in the form of an iridescent film.

Amongst the substances used were these.

Ethereal solutions.	{	Citronelle oil (volatile).
		Olive oil.
		Russian tallow.
		Castor oil.
		Camphor in alcohol.
		Methylated spirit.
		Kreosote.
		Oil of turpentine.
		Ether.
		Benzol.
Chloroform.		

Thin films of each of the above were tried at least ten times; in every case the films were iridescent excepting those of olive oil, camphor, and tallow; in most instances the films were set aside for forty-eight hours; and as a further proof one flask of each was allowed to remain for five days and nights; in the meantime the temperature was twice lowered to 33° F. by means of ice, yet although a shower of crystals of the anhydrous salt fell, crystallisation did not ensue, still on uncovering the flasks at the end of the time, and exposing them to the air, the solutions at once became solid. Out of over 100 experiments made with thin films, not a single one crystallised until the solution was exposed, or a dirty body inserted.

May I be permitted to suggest a possible explanation of the activity which Mr. Tomlinson found to be possessed by thin films of oils and other fluids, and of their inertness while in the form of a disk or lens.

Mr. Tomlinson says, "thin fluids, such as ether, benzol, &c., may be taken up by a dropping-tube, fatty oils on a clean glass rod, and the watch-glass gently removed; a drop of the liquid is to be deposited on the surface, the tube or rod to be slowly withdrawn, and the watch-glass replaced."\*

To me, this method seems to have the serious disadvantage of exposing both the contents of the flask and the oil or other fluid to the air, and in such a way that, should crystallisation be subsequently set up, you have no means of telling whether it is due to the action of the oil, &c., added or to nuclei which may have slipped in during the necessary movements. For nuclei may have fallen in and been arrested by the lens or disk of oil; all the time that such nuclei float upon this surface of course they do not come in contact with the solution, neither do they, perhaps, when the lens is broken up into small globules, which, although small, are perhaps immense in proportion to the size of the nuclei; but now, on spreading the fluid out into a thin film, which is of excessive tenuity, the nuclei may penetrate through its thickness to the under surface of the film or even sink through, and then act upon the solution.†

That the action which Mr. Tomlinson found set up by thin films starts from several points at once may be accounted for, perhaps, by the nuclei being scattered by the jerk necessary to spread out the fluid; otherwise, the crystallisation might, under other circumstances, have started in the horizontal projection of the flask's aperture, as it usually does when a solution is exposed to the air by the removal of the cover.

(To be continued).

ON THE  
SOLUBILITY IN WATER OF THE OXALATES OF  
SODIUM, POTASSIUM, AND AMMONIUM,  
AT THE  
ORDINARY TEMPERATURE OF THE AIR.\*

By WILLIAM RIPLEY NICHOLS.

IN determining the solubilities of the salts experimented upon, the method employed to obtain solutions, saturated at the observed temperatures, was as follows:—Considerable quantities of the salts operated upon—several times as much as would be likely to dissolve in the amount of water used—were put into glass-stoppered bottles, which were then half filled with distilled water, and placed in a pan of water so as to be immersed up to the necks. The operation was carried on in a room where the variation of temperature was slight, such variation being noted by means of a thermometer suspended in the pan of water.

The bottles were shaken conscientiously at frequent intervals for two or three days, and, finally, portions of the solutions were filtered through dry filters into tared flasks, and weighed. As a rule, the thermometer had indicated a constant temperature for several hours previous to the filtration.

The amount of oxalic acid in the weighed solution was determined by titration with permanganate of potassium, standardised against pure oxalic acid, and, from this result, the amount of salt dissolved was calculated.

In every case but one the salts were prepared by myself; and in every case the character and purity of the salt in question was ascertained by titrating a weighed portion of the dry salt with the standard solution of permanganate of potassium.

*Oxalate of Sodium,  $\text{C}_2\text{Na}_2\text{O}_4$ .*

This salt was prepared by neutralising a hot solution of oxalic acid with pure carbonate of sodium. The oxalic acid used in preparing this, as well as the other salts, left, upon ignition, 0.03 per cent ash.

*Solubility.*—Temperature at time of filtration, 13° C.

Temperature had varied, during solution, from 11° to 13.5°.

100 parts of the solution, saturated at 13°, contain:—

I.	II.	III.	Mean.
3.063	3.066	3.047	3.059

parts of the crystallised salt.  
Or 100 parts of water, at 13°, dissolve 3.156 parts of the crystallised salt.

Or 1 part of the crystallised salt is soluble in 31.6 parts of water, at 13°.

*Binoxalate of Sodium,  $\text{C}_2\text{NaHO}_4 + \text{aq}$ .*

This salt was prepared by adding 58.5 grms. (1 eq.) of chloride of sodium, in solution, to a hot solution of 63 grms. ( $\frac{1}{2}$  eq.) of crystallised oxalic acid, and re-crystallising the product deposited from the solution when cold.

*Solubility.*—Temperature at time of filtration, 10°.

Temperature had varied between 5° and 10°.

100 parts of the solution, saturated at 10°, contain:—

I.	II.	III.	Mean.
1.40	1.39	1.55	1.45

parts of the crystallised salt.  
Or 100 parts of water, at 10°, dissolve 1.48 parts of the crystallised salt.

Or 1 part of the crystallised salt dissolves in 67.57 parts of water, at 10°.

*Oxalate of Potassium,  $\text{C}_2\text{K}_2\text{O}_4 + \text{aq}$ .*

This salt was prepared by neutralising a commercial sample of quadroxalate of potassium with carbonate of potassium, and re-crystallising twice.

*Solubility.*—Temperature at time of filtration, 16°.

Temperature had varied between 12° and 16°.

(The temperature had remained at 16° for several hours.)

\* CHEMICAL NEWS, August 26th, 1870, p. 98.

† That nuclei can do so is shown by the rapid crystallisation of a solution when exposed to the air, although a film of oil, tallow, turpentine, &c., may cover its surface.

\* From the *Proceedings of the American Association for the Advancement of Science*, 1869.



100 parts of the solution, saturated at 16°, contain:—

I.	II.	Mean.
24.73	24.89	24.81

Or 100 parts of water, at 16°, dissolve 32.99 parts of the crystallised salt.

Or 1 part of the crystallised salt is soluble in 3.03 parts of water, at 16°.

*Binoxalate of Potassium*,  $4(\text{C}_2\text{KHO}_4) + \text{aq.}$

This salt was prepared by neutralising a certain quantity of oxalic acid with carbonate of potassium, and adding an equal amount of oxalic acid.

*Solubility.*—Temperature for three hours preceding filtration, 8°.

Temperature had varied between 8° and 10.5°.

100 parts of the solution, saturated at 8°, contain:—

I.	II.	III.	Mean.
3.680	3.681	3.668	3.676

Or 100 parts of water, at 8°, dissolve 3.816 parts of the crystallised salt.

Or 1 part of the crystallised salt is soluble in 26.21 parts of water, at 8°.

*Quadroxalate of Potassium*,  $\text{C}_2\text{KHO}_4, \text{C}_2\text{H}_2\text{O}_4 + 2\text{aq.}$

This salt was prepared by re-crystallising a sample of commercial "binoxalate of potash."

*Solubility.*—Temperature at time of filtration, 13°.

Temperature had varied between 12° and 14.5°.

100 parts of the solution, saturated at 13°, contain:—

I.	II.	Mean.
1.774	1.784	1.779

Or 1 part of the salt is soluble in 55.25 parts of water, at 13°.

Or 100 parts of water, at 13°, dissolve 1.81 parts of the crystallised salt.

*Oxalate of Ammonium*,  $\text{C}_2(\text{NH}_4)_2\text{O}_4 + \text{aq.}$

This salt was prepared by neutralising a hot solution of oxalic acid with ammonia-water.

*Solubility.*—Temperature at time of filtration, 15°.

Temperature had varied between 13.5° and 15°.

100 parts of the solution, saturated at 15°, contain:—

I.	II.	Mean.
4.028	4.076	4.052

Or 100 parts of water, at 15°, dissolve 4.22 parts of the crystallised salt.

Or 1 part of the crystallised salt dissolves in 23.69 parts of water, at 15°.

I verified the statement of Heintz,\* that this salt is less soluble in a solution of chloride of ammonium than in pure water. I added chloride of ammonium to a concentrated solution of the salt, and there were deposited small crystals which gave by titration 50.93 per cent  $\text{C}_2\text{O}_3$ , showing that they were actually the normal oxalate.

*Binoxalate of Ammonium*,  $2[\text{C}_2(\text{NH}_4)\text{HO}_4] + \text{aq.}$

This salt was prepared by neutralising a certain quantity of oxalic acid with ammonia-water, and then adding an equal quantity of oxalic acid.

*Solubility.*—Temperature at time of filtration, 11.5°.

Variation of temperature, slight.

100 parts of the solution, saturated at 11.5°, contain:—

I.	II.	III.	Mean.
5.89	5.91	5.88	5.896

Or 100 parts of water, at 11.5°, dissolve 6.26 parts of the crystallised salt.

Or 1 part of the crystallised salt is soluble in 15.97 parts of water, at 11.5°.

In order to ascertain whether this salt dissolved unchanged, a portion of that remaining undissolved was

titrated with the standard permanganate, and the percentage of oxalic acid found agreed with that of the original salt.

*Quadroxalate of Ammonium*,  $\text{C}_2(\text{NH}_4)\text{HO}_4, \text{C}_2\text{H}_2\text{O}_4 + 2\text{aq.}$

This salt was prepared by adding to half an equivalent of oxalic acid ( $\text{C}_2\text{H}_2\text{O}_4 + 2\text{aq.}$ ) an equivalent of chloride of ammonium ( $\text{NH}_4\text{Cl}$ ), as described in the preceding paper.\*

*Solubility.*—Temperature at time of filtration, 7.75°.

Temperature had varied but slightly.

100 parts of the solution, saturated at 7.75°, contain:—

I.	II.	III.	Mean.
2.45	2.46	2.46	2.46

Or 100 parts of water, at 7.75°, dissolve 2.52 parts of the crystallised salt.

Or 1 part of the crystallised salt is soluble in 39.68 parts of water, at 7.75°.

*Oxalic Acid*,  $\text{C}_2\text{H}_2\text{O}_4 + 2\text{aq.}$

A portion of pure crystallised oxalic acid was taken, and its solubility determined to be as follows:—

*Solubility.*—Temperature at time of filtration, 14.5°.

Variation of temperature, slight.

100 parts of the solution, saturated at 14.5°, contain:—

I.	II.	III.	Mean.
8.668	8.777	8.754	8.733

Or 100 parts of water, at 14.5°, dissolve 9.56 parts of the crystallised salt.

Or 1 part of the crystallised salt is soluble in 10.46 parts of water, at 14.5°.

## ON THE APPLICATION OF IODINE AND BROMINE FOR THE DETECTION OF GOLD WHEN IN MINUTE QUANTITIES.

By W. SKEY,

Analyst to the Geological Survey of New Zealand.

THE large number of non-auriferous, or but slightly auriferous, specimens of quartz and pyritous rocks, which have lately been submitted here for examination for gold, has rendered it very desirable that some quicker, less laborious, and, if possible, more exhaustive, method of analysis, than the current one (that by amalgamation), should be employed.

In recognition of this I have frequently been urged by the director of this department to attempt some other process, and after several preliminary experiments I turned my attention especially to the use of iodine or bromine for this objects.

Both of these substances differ from chlorine especially in their relatively feeble affinities for hydrogen, so there would be the less to fear, that from the generation of hydrides, any great preponderance of other matters would be dissolved along with the gold we wish to separate from the sample under examination.

Iodine, indeed, has already been used with advantage in the analysis of certain meteorites, for the separation of the iron and nickel existing therein in a metallic state; these it combines with, leaving the associated silicates, iron-oxides, and sulphides intact.

It was this comportment of iodine with other substances that determined me to the trial of both it and bromine for the purpose named.

The results of my experiments certainly show that either of these agents may be safely and advantageously employed for the separation of gold from its matrices.

The following are the particulars of a few of these experiments, which besides their present use will, I think, be useful in showing what is, approximately, the smallest quantity of gold that can be positively separated and



identified, by a certain course of analysis operating upon a limited quantity. The first time, I believe, anything of this kind has been attempted.

1st. 2 grammes of roasted "buddle headings" from a quartz mine at the Thames, known from previous analysis to contain gold at the rate of one ounce, or so, to the ton, was well shaken for a little while with its volume of alcoholic solution of iodine (tincture of iodine of chemists), then allowed to subside. A piece of Swedish filter-paper was then saturated with the clear supernatant liquid, and afterwards burned to an ash; the ash, in the place of being white, as it would be if pure, was coloured purple; the colouring matter was quickly removed by bromine—a clear indication of the presence of gold. The time occupied by the whole process was twenty minutes.

2nd. 1 gramme of the same "buddle headings," mixed with such a quantity of soil as to reduce the proportion of gold present to 2 dwts. per ton, was allowed contact with its volume of the tincture for two hours, with occasional stirring; a piece of filter-paper was then saturated with the tincture, and dried, five times consecutively, and finally burnt off as before; in this case, also, the colour of the residual ash was purple, and it gave the reaction of gold.

3rd. 32 grammes of siliceous hematite, finely-pounded, was thoroughly mixed with precipitated gold to the amount of 2 dwts. per ton; then ignited, and treated with bromine water. After two hours the solution was filtered, and evaporated to a bulk of 20 minims; this gave a good reaction of gold to the "chloride of tin" test.

4th. 100 grammes of the hematite, with precipitated gold at the rate of  $\frac{1}{2}$  dwt. per ton, treated as before, but this time well washed, at the expiration of the two hours, and the washings evaporated along with the first filtrate, gave a fainter, but still decided, reaction of gold to the same test.

5th. Iodine, as tincture, substituted for bromine in Experiments 3 and 4, gave similar results; the only variation made was, that as a precautionary measure allowing for its feebler, or rather slower, action, I gave contact for twelve hours.

To compare the results of the common amalgamating process with the foregoing, I have made some careful experiments; and I find that it is not certain, with the same expenditure of labour, to get reliable indications of gold, when present in less quantity than 2 dwts. per ton, operating upon about 100 grammes of material, which is about the quantity I usually take.

In summing up the results of these experiments, it appears, then, that for qualitative examinations for gold, or for quantitative determinations in certain cases, iodine and bromine are each superior to mercury. It also appears that a proportion of gold equal to  $\frac{1}{2}$  dwt. per ton, upon a bulk of 103 grammes (about 4 ozs.) of ferruginous matters, can be easily and rapidly detected.

Of course, by operating upon larger quantities, gold could be discovered by this process, were it present in far less quantities, but this is sufficiently near for the majority of cases.

These processes are especially adapted for the separation of gold from sulphides, as the preliminary roasting is extremely favourable to them, not so much chemically as mechanically, I think; the loss in the substitution of oxygen for sulphur, amounting to 25 per cent, by weight, while the volume remains constant (or nearly so); hence there is a corresponding porosity in the product, by which it is certain every atom of it is thrown open to contact with the solution of these agents.

This mechanical accessibility obviously cannot be taken advantage of by mercury.

With sulphides these processes are practically exhaustive, while, at the same time, the simultaneous extraction of other matters is avoided, or, at any rate, is so trifling, that the proper tests for gold can be safely applied directly to the concentrated solution.

Regarding the choice between iodine and bromine, I would prefer the former, when mere traces of gold are

supposed to be present; or if the ore is in a finely divided state, as is generally the case when the matrix is iron pyrites.

In the roasting of such pyrites it is necessary to raise the temperature towards the end to a full-red heat, in order to decompose the ferruginous sulphates, since if these remained much iron would get into the solution.

In the case of much carbonate of lime being present, it is proper to gently re-ignite the roasted mineral, &c., with carbonate of ammonia, or much lime might get into the iodine or bromine solution.

On the other hand, a very high temperature is to be avoided, for, from my own experience, I find a considerable quantity of fine gold can escape detection in this way, by the partial vitrification of the more fusible of the silicates.

The identification of gold by the combustion of its salts with filter-paper, as suggested in this paper, seems to promise a rapid method of estimating it, comparatively, by the aid of a series of prepared test-papers, representing gold in different degrees of dilution.

## ON THE TREATMENT OF GELATINOUS PRECIPITATES.

By THOMAS M. CHATARD.

THE inconveniences and loss of time which attend the washing of gelatinous precipitates are familiar to all chemists. Even the methods of washing recently introduced by Bunsen are not always perfectly satisfactory in their operation when applied to this class of substances. The following method will be found, I think, to give results which leave nothing to be desired:—The solution containing the substance to be determined is to be simply evaporated to perfect dryness with a small excess of the precipitant, and the gelatinous mass stirred with a rod until it becomes a perfectly dry powder. In this manner, the precipitate diminishes extremely in bulk, and may then be washed with the greatest ease upon the filter. The evaporation is usually effected with sufficient rapidity on a water-bath. The following analyses will be sufficient to show the degree of precision attainable by this process in the cases of some of the more familiar precipitates:—

Weighed portions of potassic dichromate were dissolved in very small portions of water, reduced with chlorhydric acid and alcohol, the excess of alcohol expelled, and ammonia added in excess. After evaporation, in the manner above described, the chromic sesquioxide presented a greenish blue granular powder very easily washed.

0.7782 gr.  $K_2Cr_2O_7$  gave 0.4023 gr.  $Cr_2O_3$  = 68.02 per cent chromic acid.

1.5646 gr.  $K_2Cr_2O_7$  gave 0.8102 gr.  $Cr_2O_3$  = 68.13 per cent chromic acid.

The formula requires 68.04 per cent.

Alumina, treated in the same manner, is also very easy to wash.

2.4097 gr. potassic alum gave 0.2626 gr.  $Al_2O_3$  = 10.89 per cent.

1.9571 gr. potassic alum gave 0.2130 gr.  $Al_2O_3$  = 10.88 per cent.

The formula requires 10.86 per cent.

The process applies with almost equal advantage to iron. Weighed portions of ammonio-ferrous sulphate were dissolved in water, and sodic chloride added in large excess, to furnish solid matter to be washed out. The iron was then oxidised with nitric acid, precipitated by ammonia, and evaporated as above.

1.5824 gr. gave 0.3229 gr.  $Fe_2O_3$  = 14.28 per cent iron.

1.4840 gr. gave 0.3019 gr.  $Fe_2O_3$  = 14.24 per cent iron.

The formula requires 14.29 per cent.



Nickelous carbonate also loses its gelatinous character when treated as above. 0.2201 gr. metallic nickel gave, after solution, precipitation as carbonate, and reduction by hydrogen, 0.2199 gr. metallic nickel = 99.91 per cent of the quantity taken. Cobaltous carbonate may be treated in the same manner, but the alkali cannot be completely washed out, and the method is, in this case, not to be recommended.

It seems, at least, extremely probable that other gelatinous oxides and hydrates will give equally good results when treated in the manner which I have described.—*American Journal of Science.*

## ON FERMENTATION.\*

By Professor A. W. WILLIAMSON F.R.S.

### LECTURE I.

(Continued from p. 236).

AMONGST the processes which really are analogous to fermentation in their nature, but which differ in one particular, I must mention one other, the process of forming vinegar, or acetic acid. This large bottle contains vinegar, in a form which most of you, I dare say, have not seen. These fine white crystals are the pure substance which, mixed with water in an impure state, are generally known by the trivial name of vinegar. We call that acetic acid, or hydric acetate. The formation of this body from alcohol represents a variety of fermentation, which is of considerable importance and of frequent occurrence. Everybody who has noticed the process which takes place when animal or vegetable matter is left to itself in contact with air, especially in moist localities, must have observed that there is a gradual disappearance of the organic matter. For instance, if you leave a piece of wood in a moist place, under certain conditions of very frequent occurrence which are favourable to this process, the wood gradually gets soft, and becomes transformed into a brown substance; and, if you leave it long enough—in this country, several years generally would be needed for this purpose—it gradually disappears. If you were to put a piece of that decomposing wood into a closed glass vessel, and examine the air above it, you would find that the wood was really burning. I am using the word combustion in the ordinary chemical sense—I mean by that word that the oxygen of the air which you have enclosed with the wood is being taken up by the wood, and the products of combustion, carbonic acid and water, are being formed from the substance of the wood. One great class of the processes of fermentation is of that kind. They consist not in a mere breaking up of the materials already contained in the organic substance, but a change of their arrangements, which is due, more or less, to the absorption of oxygen; and this formation of acetic acid, or vinegar, is a case of that kind. In fact, if we were to leave some ordinary fermented wort in an open vessel, so that the alcohol were left there in the mixture in which it had been formed, we should find that the alcohol would gradually disappear, and give place to an acid substance. The process is well known to wine-makers and to brewers, and their art consists, amongst other things, in the avoidance of this process of the oxidation of their alcohol. While the acetic acid is being formed, oxygen from the air is taken up; and, in that respect, this process of acetic fermentation differs from the other three processes of fermentation which I have described. When you make alcohol and carbonic acid from sugar, the air takes no part in the process; when you make lactic acid from the sugar, the air is not wanted; and when you make butyric acid from lactic acid, then again the air may be completely excluded, and the process will go on without it. But, when you make acetic acid from

alcohol, you must of necessity allow the free and continuous access of air, and the air gives up some of its oxygen to this fermenting alcohol, to transform it into acetic acid and water by a true process of fermentation.

Now, the question arises whether this formation of acetic acid ought to be classed, as I am at present classing it, amongst the processes of fermentation. If it is due to the absorption of oxygen, you might naturally inquire whether one ought not to place it amongst the common processes of combustion, and it is right that I should state that by some authorities it is at present so classed. My reason, however, for stating what I have done, that it is a process of fermentation, is this, that it is usually affected by the action of a peculiar organism, called the vinegar-plant, an organism which I shall have occasion to show you hereafter, which does exert in that particular process the function of taking up oxygen from the air, and of inducing the alcohol to combine with it. There are many other processes by which we could get it, but the actual process by which we do get it is a process in which this vital organism, the vinegar-plant, is the agent of its formation. It might be made by mere processes of combustion, but it is made by a process of fermentation.

There is one singular feature in the first and best known of these processes—the alcoholic fermentation—which you will notice when I tell you something of the way in which the processes of fermentation present themselves, even without very great care on the part of the observer. If, for instance, you were to express the juice of some sweet fruit—say grapes—and if you were to leave that expressed juice in contact with the air for a little time, having first squeezed it through some suitable cloth or filter, so as to have it clear, of course there would be no solid particles in it when you put it aside; but, if you leave that in a tolerably warm place, in contact with the air, you would find that little solid particles would appear in this juice, that they increase in number, and that, in proportion as they increase in number, and as the quantity of them becomes greater, so does the process of effervescence—the evolution of gas from the grape juice—become more and more rapid. These little solid particles, which are not present at first in the grape juice, but which gradually make their appearance when it is exposed to the air, are what we commonly call, in the ordinary case of alcoholic fermentation, in this country, yeast—either beer-yeast or wine-yeast; it is the same organism in each case. The peculiarity of the process is this, that these substances—this yeast—which seems to make the sugar into those products which I enumerated to you, does not disappear while doing the work, but is produced by the very process. The more active the production of these yeast cells, and the more speedy the growth of these yeast cells, the more effective and rapid is the process of fermentation, and no fermentation of the kind which I am speaking of at present—the alcoholic fermentation—has ever been known to take place in the absence of these organisms. That circumstance I just mention briefly at present, but the fact that these yeast cells appear whenever the process is going on—and the more they grow the more rapid is the fermentation—has led people to suppose at first, and to believe afterwards, that these yeast cells were the agents of the transformation, the active substances which decomposed the sugar in contact with the water, and induced the transformation which we noticed. Now, the very fact that one of the two substances which are reacting upon one another chemically (because the changes are chemical in their fundamental nature), should not disappear, but should rather increase by the process, is entirely anomalous—it is entirely at variance with the simplest and best known facts of chemistry, so much so, that if it were not established upon incontrovertible evidence, I believe that most chemists would be inclined to disbelieve it, and to say it cannot be—it is impossible—it is a mistake. If you tell me, as a chemist,

\* The Cantor Lectures. Delivered before the Society of Arts.



that this yeast is transforming sugar by its action on the sugar, and that, instead of being consumed, the yeast is actually increased in quantity by doing that work, I should say it is nonsense—it cannot be, because, in all the cases of chemical action which I know best, nothing of the kind occurs, but the very opposite. When one substance acts upon another, each one disappears in the process, and is transformed into a product having other properties. I need hardly give you illustrations of that; but one or two simple cases may not be useless, as serving to fix clearly this important circumstance in your minds.

I will take, at first, one of a particularly elementary and simple kind, a process of combustion. I will take a little strip of metal, magnesium wire, and will hold it for a short time in the flame of a spirit-lamp, so as to raise it to a sufficiently high temperature. The light you see emitted is due to the combustion of the oxygen in the air with the metal magnesium, which I hold in my hand. This is one of the simplest possible cases of chemical action. The metal has disappeared. The strip of wire is gone, and oxygen from the air disappeared also. At the same time a white powder was formed. I dare say you did not notice it, but here is a quantity of the same substance in a bottle. It consists of oxygen from the air combined with the metal magnesium, and the point is this—that all the magnesium which took part in that process disappeared and went to form this white powder, and all the oxygen which took part in the process also disappeared. The two united together, each disappeared as such, and went to form this new product. And, moreover, we can tell, from an examination of the proportions in which the substances combine, exactly what weight of oxygen would disappear for every part by weight of magnesium. If you burn, for instance, 3 grms. or 3 lbs. of magnesium, you would require exactly 2 grms. or 2 lbs. of oxygen. For instance, 3 lbs.' weight of magnesium would combine with 2 lbs.' weight of oxygen, and the product of the two together would be 5 lbs. in weight. I may show you the same thing with soda—not the substance which is commonly called by that name, which is a carbonate of that base. I have here a little pure soda solution in a bottle. I will pour some into a beaker-glass, and I will show you one property which characterises it—viz., that of changing the colour of this red paper into blue. Now, I will pour some of this acid body, the oil of vitriol, into another beaker-glass. If I put the paper which has been discoloured into this pure acid, it would be dissolved; but I will dilute some of it with water, and then you will see that paper, which has been rendered blue by the agency I have just used, is brought back again to red by the agency of this acid. Now, if I mix the acid with the soda, we shall have audible evidence of violent action going on. I will not go on with the process, but I have purposely taken the two substances in presence of very little water, in order to show you that the heat evolved makes the liquid boil with great violence. I could have avoided that by adding water in the first place, but I wished to show you the vigour with which they unite together. If I were to go on adding acid to the soda, little by little, feeling my way until I had just completed the action, I should have got some water formed and some of the beautiful salt which I have here, a body which is neither soda nor acid; it is a salt called Glauber salt, or sodic sulphate, and all my materials would have disappeared in the process. If I use them in proper proportions, all the acid and soda would disappear, and go to form these two other products. I might dissolve some of this sulphate in water, and might put red paper or blue into it, and it would not affect either of them; it is perfectly neutral in that respect. The proportions by weight in which this combination takes place is this. If I add 40 parts, by weight, of soda, and 49 of oil of vitriol in a state of purity, I should have as the result, 18 parts by weight of water, and 71 of sodic sulphate; and, if I

add together the weight of my materials and the weight of my products, I get the same—89. Nothing disappears in the process; all the acid and all the base which takes part in it is employed. Each particle which took part in the process disappeared as such, and it passed over into another form.

I will mention one other case, because it is somewhat more complex. I may take the case which I was showing you just now, the white marble and hydric chloride, or muriatic acid, which I used for making the carbonic acid gas. In that case, I used two materials, carbonate of lime, as it is commonly called, and hydrochloric acid. We get three products—on the one hand is a salt, which is commonly called chloride of calcium, a solid substance used for drying gases, as it has a great affinity for water; another is water; and the third, as I showed you, carbonic acid gas. There, again, we have precisely the same thing. All the marble and all the hydric chloride which takes part in the formation of those three products disappeared as such, and they resolved themselves into other compounds possessing different properties; but the weight of the products is equal to the weight of the materials. That rule holds good throughout all ordinary cases of chemical action.

On the other hand, in fermentation it is not so; one of the active substances is formed, and the more active the fermentation, the more does it grow. In fact, if you want to get yeast, you must go to a place where the breaking up of sugar into alcohol and carbonic acid is going on; or, if it is in the south, you must go to where wine is being made—you go to a wine-maker and get the yeast from him. The only way of getting yeast is from that process of fermentation which sets in spontaneously under the conditions I named to you.

(To be continued.)

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#### DR. SEYFERTH'S PROCESS FOR THE PURIFICATION OF SYRUPS AND MOLASSES IN THE MANUFACTURE OF SUGAR.

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THE juices and liquors employed in the first extraction of sugar from the raw material it is contained in, as well as the syrups resulting from the sugar refining processes, all generally contain a certain quantity of alkaline substances, varying, however, in quantity with the various conditions of the soil on which the beet-roots have been grown and the mode of cultivation. The juice of the ripe sugar-cane, however, is at the moment of being squeezed out of the cane slightly acid to test-paper. By treating the saccharine juices with milk of lime, several of the bases of the alkaline salts present in the juices are separated from the acids they were at first combined with, and by thus being set free and remaining mixed with the sugar, impede its crystallisation. One part of alkaline matter can absorb as much as four parts of sugar; and some kinds of molasses (chiefly from beet-root) contain as much as 8 per cent of alkali.

The means hitherto tried to remedy this defect, viz., neutralisation of the alkalies by acids, have failed in practice, chiefly for two reasons: first, because the acids have not been applied at such a stage of the process of manufacture as to enable the acids to seize upon the whole of the alkalies; and secondly, because it has never been possible to prevent the injurious effect of even a very slight excess of acid upon the sugar itself; while, moreover, a difficulty is encountered by the very variable quantity of alkali present, whereby the proper quantity of acid to be applied varied every moment, thus rendering their application totally unsuited in any but very skilled hands. Among the acids applied sulphuric and phosphoric have been most used, but their use could not but be very limited, since even a very slight excess thereof was far more to be dreaded, on account of its highly injurious



effects upon the sugar, than almost any amount, so to say, of alkalis. Sulphurous acid has been used and recommended in various forms, even as far back as 1810 (Proust), both on account of its activity as acid in saturating alkalis, as well as its power as a bleaching agent, by thus rendering the sugar more white-coloured.

Dr. Auguste Seyferth, managing-director of the Brunswick sugar (beet-root) refinery, has hit upon a plan for the use of sulphurous acid, which, according to the unanimous and unbiassed testimony of no less than 100 proprietors of establishments wherein the process invented and brought out by the Dr., since September, 1869, is applied, answers the purpose admirably, yielding more produce and of better quality in every respect. The process alluded to consists essentially in the introduction of sulphurous acid, either in gaseous form, or in very weak aqueous solution, into the vacuum pans. By this arrangement it is possible to bring all particles of the sugar solution (syrup) into contact with sulphurous acid, and to eliminate, by the joint action of heat and vacuum, any excess of that acid, which, however, not only saturates free alkalis and carbonate of lime, but also sets the organic acids, which might be present as alkaline salts, free from these combinations; the sulphurous acid taking hold of the bases they were combined with, while the greater part of these organic acids are volatilised along with the steam, and thus the sulphurous acid promotes the good and ready crystallisation of the sugar, while its action as a decolouriser comes also advantageously into play.

The Seyferth process embraces two main operations, viz., the manufacture of the sulphurous acid as gas, or as aqueous solution, and the application of the acid (chiefly in aqueous solution, being more readily manageable) and its introduction in the vacuum pans. The sulphurous acid is manufactured at the works (beet-root sugar manufactories or sugar refineries) by the well-known expedient of burning sulphur in suitably constructed ovens, and carrying the products of combustion, previously cooled so as to condense any vapours of sulphur, into a leaden vessel wherein the gas is met by a suitably arranged current of water so as to become entirely absorbed. The aqueous solution thus obtained is put into casks, or other suitable vessels, and from these a tube, provided with taps, leads to the vacuum pans, wherein the liquid is sucked simultaneously with the sugar solution. The party in attendance upon the boiling in the vacuum pans, while causing the sulphurous acid to be aspired, takes care to test from time to time (this is done by means of the contrivance technically known as proof-stick) the contents of the pan by applying blue litmus paper, so as to ensure the contents of the pan remaining alkaline; but if by a mishap the acid is in excess, this is remedied by sucking in a fresh quantity of sugar solution, while a slight increase of the rapidity of evaporation (the turning on of more cold water to the condensers) will rapidly eliminate and volatilise any excess of sulphurous acid, which, when in quantities of 50 to 100 kilos. excess of the weak solution, does not affect the sugar.

The quantity of sulphurous acid solution applied varies from 4 to 8 or from 10 to 15 per cent of the bulk of liquid (syrup) to be evaporated, but these figures are not absolute but only relative, since experience has already proved that the requirements differ for different localities. The process alluded to is stated to possess, besides the advantages already named (production of better quality and larger quantity of sugar), the good qualities of being applicable at very little cost; to require no inconveniently large space; to be applicable to any already existing manufactory without causing any temporary stoppage of work; its application is readily learned by the sugar boilers. According to the communications made on this subject by the members assembled at the general meeting of German sugar manufacturers and refiners, at Berlin (last May), and a similar meeting lately held at Prague, this process is highly appreciated, and largely eulogised as an immense improvement in this branch of industry.

## CONTRIBUTION TO AN IMPROVED METHOD OF ANALYSING MINERAL WATERS.

By Dr. MOHR.

WHEN large quantities of an alkaline mineral water are evaporated in a porcelain dish, the saline matters, chiefly carbonates of the earths, form a crust at the bottom of the vessel, so fixed that it is impossible to loosen it, while it need hardly be said that the residue cannot be weighed, while in the large basin, with accuracy. The author, therefore, adds to the water a sufficient quantity of formic acid, so as to render the fluid distinctly acid to test-paper, and then proceeds with the evaporation cautiously, and finishing it on a water-bath or in the drying box; the residue is taken up with a small quantity of distilled water and the solution filtered through a small filter, the filtrate being run into a platinum crucible, or basin of sufficient size, yet at the same time suitable for accurate weighing. The filter contains all the silica that was contained in the water, and, after washing and drying that substance, is readily estimated by well-known methods.

The filtrate in the platinum vessel is evaporated to dryness, and gently heated to redness; the formic acid does not, as acetic acid does, leave a carbonaceous residue, but is entirely converted into volatile compounds, viz., two atoms of carbonic oxide, and one atom of water; all the salts, therefore, which the mineral water contains, are, after the heating to redness, converted to the same condition they were in before the addition of the acid, and the residue, after weighing, is treated with boiling distilled water; this solution is filtered, and the insoluble residue on the filter treated by the well known methods.

The soluble soda-salts contain, or rather are combined with, carbonic and sulphuric acids and with chlorine; in order to estimate with the same quantity of substance each of these three acids, the author suggests the following method:—The aqueous solution of the salts is boiled, and, while boiling, a neutral solution of acetate of lime is cautiously and drop by drop added, so as to decompose the carbonate of soda with the formation of carbonate of lime in the form of arragonite; the carbonate of lime is collected on a filter and to the filtrate is added acetate of baryta, while the fluid is kept in ebullition; the precipitate sulphate of baryta is collected again upon a filter, serving the purpose of the estimation of sulphuric acid; in the filtrate the chlorine is estimated by means of nitrate of silver, the solution having been acidified, previous to the addition of the solution of that salt, with nitric acid.

In this manner three different precipitates are obtained, from each of which the calculation for the corresponding soda-salts is made. Carbonate of lime  $\times 1.06 =$  carbonate of soda ( $\frac{53}{50} = 1.06$ ). Volumetrically, the carbonate of soda is first estimated with the aid of tincture of cochineal and 1-10th of nitric acid; in the same fluid chlorine is volumetrically estimated by means of a solution of chromate of potassa, and 1-10th of nitrate of silver solution; after the addition of chlorhydric acid, the solution is filtered and the sulphuric acid in the filtrate is estimated gravimetrically by well-known methods.—*Zeitschr. für Anal. Chem.*

## PROCEEDINGS OF SOCIETIES.

### GLASGOW PHILOSOPHICAL SOCIETY. (CHEMICAL SECTION).

THE opening meeting of the session took place on Monday night in the Lecture Hall, Corporation Buildings. Alexander Whitelaw, Vice-President, delivered the introductory address.

After making a feeling allusion to the death of Dr. Penny,



Dr. W. Allen Miller, and Dr. Matthiessen, and expressing regret at the loss which chemical science has sustained thereby, Mr. Whitelaw proceeded to notice some of the most recent discoveries and improvements in industrial chemistry. Among others, he referred to Mond's process for the recovery of sulphur from alkali waste, Weldon's continuous method of obtaining chlorine, Deacon's process for making chlorine without the use of manganese, by passing hydrochloric acid gas over hot bricks saturated with sulphate of copper, whereby, by a peculiar reaction hitherto unknown, water and chlorine are produced, while the copper salt remains intact and active for an indefinite time. After touching on various points of interest with regard to the utilisation of certain by-products, Mr. Whitelaw described a new process now in operation on a large scale for the recovery of the small quantity of the precious metals in the copper liquors obtained from burnt Spanish pyrites, by Henderson's process. He also described the process for the manufacture of ferro-manganese or spiegeleisen, from the residual oxide of iron from the above process. Passing to organic chemistry, Mr. Whitelaw described a new discovery, by Bock, of Copenhagen, and now in operation for the manufacture of stearic acid without either lime saponification or distillation with superheated steam. Before concluding, Mr. Whitelaw shortly reviewed a recently-published "Digest of the Sewage Question," prepared for the committee of the British Association, and stated that, after a careful study of the whole evidence, and notwithstanding rather strong preconceived opinions to the contrary, he was forced to the conviction that the soil is the only perfect purifier of sewage—that intermittent filtration through the soil—in other words, irrigation by sewage—is the only thorough way of utilising the manurial matters contained in, and sweetening the effluent waters from sewage. That sub-soil, water, and rain-water should be, if possible, run by means of deep drains into the nearest water-course; and that the house-sewage should be conveyed by means of pipe sewers of moderate size, capable of being flushed to the out-fall works, there to be roughly filtered before being used for irrigation. Mr. Whitelaw then read extracts in support of his opinion that sewage farms are not hurtful to health, but are, on the contrary, if properly managed, the reverse.

## NOTICES OF BOOKS.

*Snuff-Taking: its Utility in Preventing Bronchitis, Consumption, &c.* (With prescriptions.) By JOHN C. MURRAY, M.D., F.A.S.L. London: J. Churchill and Sons. Newcastle-on-Tyne: D. H. Wilson. 1870.

THIS essay is an extension of a paper read before the Medical Section of the British Medical Association, held at Newcastle-on-Tyne in August last, and the subject it treats of is fairly and scientifically put forward. It is divided into seven chapters, and contains, moreover, a large appendix, including prescriptions and correspondence. The author has done good service in calling the attention, not only of medical men, but also of the public in general, to the subject of snuff-taking.

*Elementary Questions in Chemistry for Students.* First series: Thirty Papers on Heat and Metalloids. By THOMAS WOOD, Ph.D., F.C.S., Lecturer on Chemistry at the Brighton and Lancing Colleges, &c. London: J. Helm, 10, Brownlow Street, Holborn. Brighton: H. C. Treacher. 1870.

THERE are two methods of giving young people instruction in chemistry, in the absence of a regular working laboratory. First, by lectures only, without any examination or further notice of the subject. This plan awakens interest in the pupils, teaches them to observe, enlarges their ideas, acquaints them with many things necessary

for everyone to know, and is comparatively of much use; but it is almost valueless as far as really mastering the science is concerned. Secondly, by lectures given in the regular school hours, partaking more of the nature of an ordinary school lesson, where any boy may be asked questions during the lecture, and an examination on each lecture is held immediately afterwards—the examination being made compulsory, like any other work. For some years past the plan has been followed at the Brighton College of setting the examination paper *before* the chemical lecture is delivered, the lecturer answering, in the course of his lecture, each question on the paper. The boys subsequently answer the questions in writing, each master looking after the answers in his form. Such success has attended this plan that Dr. Wood has been induced to print these questions, so that a similar plan may be followed at other schools. It is proposed to print three series of questions in sets of ten, of which the present series is the most elementary. The first series of papers requires lectures illustrated by simple experiments, intended only to teach plain facts and give elementary information, such as shall enable the pupil eventually to grasp the principles of the science in a more advanced course of study. The second series will enable the examiner to see if the boy has intelligence and ability sufficient to put the facts together which he has learnt in the first course of lectures, use them in a rational way, and understand the principles on which the science is built. The third series will be a set of still more advanced questions, requiring the student to use his reasoning power, and to apply the principles of the science with accuracy to new cases. The series before us is intended to accompany a first course of lectures, and is so arranged that each question requires only a single answer, and many of them may be answered by a word. The author's little book is published very opportunely, now that the Elementary Education Act is about to come into operation.

We sincerely hope that enlightened, liberal minded, and clear headed men will be elected as members of the Education Board, and that they will see that the first and foremost point in education is to make children well grounded in the elements of all branches of knowledge. Chemistry pertains especially, along with other physical sciences, to the subjects of sound elementary education, which ought to be thoroughly unsectarian, in the fullest and strictest sense, so absolutely that even Mahometans or Buddhists from India, as well as Jews and Christians, can attend the school and study together. The example of the United States, of Switzerland, Belgium, and the Netherlands, as well as of other countries, proves, not only the possibility, but also the perfect fitness, of this arrangement. And it should not be forgotten that, as regards the teaching of the elements of physical and natural history sciences, they widen a man's views, sharpen his intellect, and give him power in various ways; and this power, rightfully and judiciously applied, cannot fail to benefit the individual, as well as the agglomeration of individuals, termed the nation.

## CORRESPONDENCE.

### PRESERVATION OF STONE.

*To the Editor of the Chemical News.*

SIR,—In a letter by Mr. A. H. Church, which appeared in the last number of the CHEMICAL NEWS, the originality of my proposal to apply the superphosphate of lime as a means of preserving stone from decay is called in question, and the report of the Chemical Sub-Committee (Houses of Parliament) is cited, as proving a prior use, in this country, of phosphoric acid and the superphosphates for the purpose mentioned. But Mr. Church has failed to notice that this report bears date June 17th, 1861—one



month later than my proposal (May 13th)—and that it is to my process that reference is here made in the report. I have Coignet's specifications now before me, and no mention is made of the superphosphate being applied to stone, but only to the surface of large artificial blocks, for the purpose of enabling them to take a coat of paint.

If Mr. Church (or Mr. Ransome) believes he has secured a good patent for a "Combined Process," embodying your own dialysed silica and my superphosphate, what is to prevent me from patenting an "Improved Combined Process," which differs only from his by finishing up with a last wash of superphosphate applied upon the other ingredients? This would prove quite successful, but, in the event of such a course being permitted, to what monstrous absurdities would the Patent Laws of England be lending support!—I am, &c.,

JOHN SPILLER.

London, Nov. 14th, 1870.

## MISCELLANEOUS.

**Method for Repairing Porcelain Evaporating Basins when Cracked.**—Dr. Walzl recommends, first to dry the vessels thoroughly in a drying-stove, and next to fill them with a rather concentrated solution of silicate of soda and leave the solution in the vessel for about twenty-four hours after the liquid has been poured out. The vessel is gradually dried at a gentle but increasing heat, and it will then be found to hold liquids again and be fit for further use.

**Cleaning Oil Painted Surfaces.**—Take a piece of soft flannel, put it in warm water, and squeeze it till it feels dry; next dip it gently on to some very finely pulverised French chalk, and rub the painted surface with the flannel; the effect will be the removal of all dust, greasy matter, and dirt; the surface is next washed with a clean sponge and water, and dried with a piece of soft wash-leather. This method does not injure the paint like soap, and produces a very good result.

**Testing Carbonate of Lead for its Goodness as an Ingredient of the Manufacture of Crystal Glass.**—Dr. A. Neujean.—Since the presence of iron and copper are the only impurities which interfere with the use of white lead for the purpose above-named, the author tests for the presence of these substances colorimetrically in the following manner:—From 20 to 40 grms. of the substance (white lead), if apparently very pure, and only 10 grms. if obviously impure, are dissolved in dilute sulphuric acid, and next precipitated by means of sulphuric acid; the liquid having been filtered is evaporated and reduced to a small bulk, and next, by the addition of water, made up to a constant volume, after which a few drops of sulphocyanide of potassium are added; the presence of copper is tested for by a similar operation, ammonia being applied instead of the salt just alluded to.

**Preparation of Tannic Acid.**—O. Rothe.—The author recommends the following process as the best and simplest:—Eight parts of pulverised nut-galls (the Chinese galls are preferred by the author) are macerated for two days in a mixture of twelve parts of ether and three of highly rectified alcohol, care being taken frequently to move the vessel containing the mixture. The liquid having been poured off from the residue, the same quantity of ether and alcohol is poured on the powder, and, after a short maceration, the pulpy mass is pressed; the mixed liquids are left at rest for some twenty-four hours, after which there are added to the fluid twelve parts of water; this having been done, the mixed alcohol and ether are removed by distillation, the greenish resinous matter which will be found floating on the residual liquid is removed by filtration, and after that the liquid is evaporated to dryness by means of steam and the residue ground to powder.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

*Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

**NOTE.** All degrees of temperature are Centigrade, unless otherwise expressed.

*Journal de Pharmacie et de Chimie, September, 1870.*

This number contains the following original papers and memoirs:—

**Modifications which the Alkaloids of the Cinchona Barks Undergo under the Influence of Certain Physical and Mechanical Agents.**—M. Carles.—The author relates the results of some experiments made with the view to investigate the action and influence of long-continued grinding and exposure to air of the powder thus obtained of cinchona barks, and, next, the action of sunlight, moisture, and heat upon that powder. It appears that the mechanical operation of grinding, even if continued for some time, does not alter in composition, nor lessen the quantity of the alkaloids present in the bark; but exposure to sunlight in a stoppered bottle for about a month decreases the quantity of alkaloids by about 5 per cent, while the prolonged action of moisture and heat produce similar results.

**Decomposition of Oxalic Acid.**—M. Carles.—The contents of this paper give an account of a series of experiments made with the object of ascertaining the action of currents of pure oxygen and hydrogen upon aqueous solutions of pure oxalic acid, as regards the decomposition of that substance into carbonic and formic acids at a temperature of 100°. The author has also found that perfectly pure nitrogen has the same effect upon a solution of pure oxalic acid at 100°, dissociating it into carbonic and formic acids; but the cause of this action is not yet explained.

**Modifications which Inuline undergoes, Spontaneously or by the Combined Action of Heat and Water.**—M. Lefranc.—This lengthy essay treats, in the first place, on the changes which inuline suffers in the living parts of plants (chiefly roots and tubers). It appears that the inuline is gradually converted into a sugar-like substance, which the author calls *inulose*, and into soluble inuline, which, the author states, partakes, in many of its properties, of levuline. The former of these substances is optically neutral, capable of fermentation, and has the aspect of glucose. Levuline is levogyrate, not capable of fermentation, and has the aspect of starch; neither of these two substances are detected by the cupro-potassic reagent. The author states, that when inuline in solution is boiled for thirty hours with water at 100°, it yields the same products as those just mentioned as being the result of the action of the vital process of the plants upon inuline.

**Experiments made with the Salts of Manganese.**—A. Commaille.—This lengthy essay treats on the action of several substances (chiefly acids) upon permanganate of potassa. The essay is divided into the following sections:—Action of nitric, sulphuric, hydrochloric, iodic, arsenious, oxalic, acetic, tartaric, citric, benzoic, and uric acids upon the permanganate of potassa, the action being aided by alcohol, ether, and sometimes electricity. It is not well possible to give a succinct account of the reactions which take place in each instance, but it appears that, when the permanganate is dissolved in chlorhydric acid, and an electric current conducted through that solution, hydrogen gas is abundantly given off. The same phenomenon takes place under similar conditions with a solution of the permanganate in oxalic acid; but, without the electric current, ozonised oxygen is given off.

**On Melassimetry.**—M. Maumené.—This paper treats on the estimation of the value of raw sugars; its contents are reserved for full translation.

**Properties of Iodic Acid.**—A. Ditte.—This paper treats on some reactions of anhydrous and hydrated iodic acid. The former substance is a white-coloured powder, very soluble in water, and insoluble in ether, chloroform, sulphide of carbon, and hydrocarbons generally; sp. gr. at 0°, 4.487. The oxidising properties of this substance are very energetic. At the ordinary temperature, this action is not so manifest; but, at an elevated temperature, this acid acts energetically, even upon hydrogen (under pressure), upon carbonic oxide, sulphurous acid, and ammonia, while even at the ordinary temperature sulphuretted hydrogen gas and hydrochloric acid gas are acted upon. The monohydrated iodic acid is also a solid substance; sp. gr. at 0°, 4.629. The reactions of the concentrated solution of this acid, and its behaviour with most of the metalloids, is described at length. Benzene and acetylene are decomposed by anhydrous iodic acid at 220°, yielding carbonic acid and water.

**Monobromated Iodhydrates and Chlorhydrates of Ethylene and Propylene.**—E. Reboil.—This essay treats on the action of iodhydric and chlorhydric acids upon the substances above named. When iodhydric acid acts upon the monobromated ethylene at the ordinary temperature, there is only formed an iodhydrate of the monobromated ethylene; but, if the action is assisted by heat, two isomeric compounds are formed. The general result of the action of the hydracids upon the monobromated compounds of ethylene and propylene is the formation of isomeric compounds; but, whereas with bromhydric acid the degree of its concentration is in play, with iodhydric acid only the temperature is of any influence. Chlorhydric acid yields only one product, which is a chlorhydrate for bromated ethylene and a chlorobromide for bromated propylene.



## NOTES AND QUERIES.

**Answer to Query.**—In answer to X. Y. Z. in your issue of the 4th November, the book he wants can be obtained of Mr. Freeman, 27, Church Street, Soho.

**For Exchange.**—Well crystallised specimens of the rare mineral "Atacamite," new to Britain; see last week's CHEMICAL NEWS for properties. For other rare minerals or copper ores.—H. H., 12, Portland Place, Layerthorpe, York.

**Dyeing Queries.**—(Reply to A. Sykes.)—We cannot do better than to refer you to a work on "Dyeing and Printing," which the Editor of this paper has in the press; it will give you the information you require; and, in the meantime, you might consult the work named in the first line of our "Notes and Queries," No. 571; or Dr. Calvert's work quoted in "Notes and Queries," No. 568.

**Decolourising Property of Animal Charcoal.**—(Reply to "A Student.")—If you would read the section treating on "Bone-Black or Animal Charcoal," pp. 162 and following, in the "Treatise on the Manufacture of Beet-root Sugar," edited by the Editor of this paper and published by Messrs. Longmans, Green, and Co., you will obtain an excellent insight into the subject you desire to be informed upon.

**Manufacture of Anthracene.**—(Reply to J. Bernays.)—As far as the replies we have received in reference to the distilling or refining of raw petroleum go, there is at present either none at all refined in this country, or it is only done on a very limited scale. It might be that the oil obtained in the distillation of the crude ozokerite, or the residues of that distillation, contain anthracene, but we have no positive evidence to prove that, nor, as far as we have been able to ascertain this matter, is the manufacture of anthracene from these substances carried on in this country.

**Deodorising Oils.**—(Reply to "Nindex.")—Try the following methods:—The oil gently heated on a water-bath is stirred for some time with about 1 per cent of good chloride of lime, previously made into a milk by trituration with water; about  $1\frac{1}{2}$  parts of oil of vitriol, previously diluted with 20 times its weight of water, is then added and the agitation renewed and maintained for at least two hours; the oil is, lastly, well washed with steam or hot water, and next filtered through charcoal; or you may agitate the oil with from 4 to 8 per cent of caustic soda lye, sp. gr. 1.2; after twenty-four hours repose the supernatant oil is decanted from the sediment and filtered.

**Sulphuretted Hydrogen Apparatus.**—(Reply to "Nindex.")—Since it appears that you chiefly aim at the prevention of the annoyance, caused by the disagreeable smell, your best plan is to enclose the apparatus, while in use, in a case or cupboard connected by suitable means with the flue of a chimney having a good draught; or you must contrive your working arrangements with the gas in such a manner as to absorb by suitable means, for instance by dry caustic lime, by granulated and freshly burnt charcoal, or by caustic or carbonated alkali, the excess or waste of gas; as to proper apparatus a vast number have been described, and you can select such as suit your work best.

## MEETINGS FOR THE WEEK.

MONDAY, 21st.—London Institution, 4. Dr. Odling, F.R.S., "On Chemical Action." (Educational Course.)  
WEDNESDAY, 23rd.—Society of Arts, 8.  
THURSDAY, 24th.—London Institution, 7.30. Prof. Morris, F.G.S., "On the Precious Metals and their Distribution."

## TO CORRESPONDENTS.

F. Piggott.—Declined with thanks.  
E. W. Parnell.—We do not see much difference between the two.  
C. R. C. Tichborne.—Your communication did not arrive in time for insertion this week.  
F. Spence.—Unavoidably postponed till next week.

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THE CHEMICAL and TOXICOLOGICAL CLASS will meet as usual every Monday and Thursday evening, at 8 p.m., commencing October 3rd.

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# THE CHEMICAL NEWS.

VOL. XXII. No. 574.

## EXPERIMENTS UPON SUPERSATURATED SOLUTIONS OF SODIC SULPHATE.

By ARCHIBALD LIVERSIDGE,  
Associate of the Royal School of Mines.

(Concluded from page 241.)

### *The Action of Crystal of Normal Sodid Sulphate upon a Supersaturated Solution of the same.*

It is a well-known fact that clean crystals of both the anhydrous salt and the modified salt ( $\text{Na}_2\text{SO}_4 \cdot 7\text{OH}_2$ ) are inactive as nuclei in a supersaturated solution of sodid sulphate.

The following series of experiments were made, because it was found by the writer that, no matter how it was attempted to render a crystal of the normal salt ( $\text{Na}_2\text{SO}_4 \cdot 10\text{OH}_2$ ) inactive to a supersaturated solution of the same, he could never succeed, yet such crystals of the normal salt could readily be made inactive to supersaturated solutions of other salts—as of alum, &c.

For example, let us take a supersaturated solution of alum, and one of sodid sulphate, and also crystals of both their salts, which crystals have just formed, and are taken from their still warm mother-liquors.

*Expt.*—A crystal of alum from its mother-liquor was added to a supersaturated solution of alum. Crystallisation immediately took place.

*Expt.*—A like crystal of alum was then added to a supersaturated solution of sodid sulphate. No effect.

*Expt.*—A crystal of the normal salt was taken from its mother-liquor and added to a solution of sodid sulphate. The solution instantly crystallised, although another crystal was inactive to a solution of alum.

*Expt.*—A crystal of magnesian sulphate was added to solutions of alum and of sodid sulphate, respectively. No effect on either, but active in a solution of magnesian sulphate.

Amongst the older observers, Ziz, Gernez, Violette, and others attributed the nuclear action to a particle of the same salt. Mr. Tomlinson was, I believe, the first to combat this view; he refers the activity of such a particle of the salt to the filmy impurities with which it is contaminated.

And, in proof that clean crystals are inactive, he brought forward the two following experiments:—

“Hydrated crystals of magnesian sulphate were introduced into the neck of a flask in which a solution of the salt was also being boiled. The crystals were left so suspended, while the solution cooled under cover; when cold, they were lowered into the solution, and found to be inactive.”\*

Dr. De Coppet objected to this experiment, on the score that the crystals had been so changed by heat as to no longer represent the normal salt.

“In the second form of the experiment, highly supersaturated solutions in clean test-tubes were plugged with cotton wool, and, when cold, placed over sulphuric acid under the receiver of an air-pump, and left for some time *in vacuo*. Crystalline crusts of the normal (*sic*) salt formed on the surface, which, by shaking, fell through the solution, without acting as nuclei; a crystalline crust of the normal salt also crept up the sides of the tube, which was also inactive because chemically clean.”

But Löwel says that it is not the normal salt which is formed on allowing a supersaturated solution to evaporate spontaneously under cover,† but the modified salt, or that

with seven atoms of water; and, in proof of this, he gives experiments and analyses of the salt thus formed.

And, further, he says—“Mais ce qui paraît certain, c'est que, sans cette action mystérieuse que l'air et les autres corps exercent sur les dissolutions, nous ne connaîtrions le sulfate de soude qu'à l'état que j'ai appelé *modifié* cristallisant avec 8 équivalents d'eau.”

The following experiment was made upon this point:—

*Expt.*—A tubulated bell-jar was fitted with a cork bearing a glass tube, which was open below and closed above; the lower end was made inactive, by means of the lamp-flame, and allowed to cool, then a flask of solution was placed under the bell. After the lapse of five minutes (in order to ascertain if nuclei had gained access), the tube was inserted and withdrawn, bearing with it a little of the solution. A capsule of sulphuric acid was next placed under the bell, when evaporation rapidly took place from the small quantity of solution on the tube, upon and within which a crust and plug of crystals were formed, and these were coated with a white pellicle of the effloresced salt. On again lowering this tube and its adherent crystals into a solution no effect was produced.

This experiment was repeated again and again, and with the same unvarying result—*i.e.*, the crystals produced by evaporation were inactive, which inactivity seems to be only explicable by accepting Löwel's analyses, especially as, in the experiments about to be detailed, the normal salt was invariably found to be active.

Next, experiments were made with recently-generated crystals of the normal salt.

*Expt.*—Two beakers, containing fully supersaturated solutions, were covered with watch-glasses, and allowed to cool; in one of the beakers, a small glass bucket, attached to a thread, had been placed and boiled up with the solution. Next, both beakers were arranged under a large bell-jar, and the silk thread from the bucket passed up between the stopper and the neck of the jar. The solutions were then uncovered, after waiting ten minutes for any nuclei which might have been disturbed to fall; a fine wire was passed down into the beaker containing the bucket, and as far as possible from the part of the solution through which it would pass on being drawn up.

The bucket, now full of the crystallised normal sodid sulphate ( $\text{Na}_2\text{SO}_4 \cdot 10\text{OH}_2$ ), was raised, and lowered into the second beaker of still fluid solution; immediately that the point of one of the crystals hanging from the under surface of the bucket touched the solution, crystallisation was set up instantaneously throughout the mass.

This experiment was performed many times, and with every possible care to prevent the entrance of nuclei other than those purposely borne by the wire.

A modification of the above plan was tried, and with similar results.

*Expt.*—A tubulated glass bell was fitted with a cork bearing two glass tubes, open below and closed above with cotton wool; they were bent, so as to permit both of them being placed in one and the same beaker, or into either separately.

In the first place, the ends of the tubes inside the bell were freed from nuclei, by passing them through a flame; two beakers of cold supersaturated solution were then placed in position under the bell-jar, and their covers removed. After waiting five minutes or so, for any dust to settle, both tubes were next lowered into one of the beakers, on opposite sides, so as to be as far apart as possible. A dirty wire was now passed down one of the tubes, when, of course, crystallisation immediately took place, and was propagated across the beaker. The second tube, with its adhering crystals, was then raised and lowered into the second beaker, when, the moment the extreme point of the longest crystal touched the surface of the solution, crystallisation immediately started from that point, and the whole contents became solid.

A third variation was then made in this experiment. One of the two beakers was replaced by a U-tube of thin,

\* *Phil. Trans.*, 1868, p. 665, and *CHEMICAL NEWS*, vol. xviii., p. 110.

† *Ann. de Ch. et de Ph.*, 1850, vol. xxv., p. 126.



hard glass, one of the before-mentioned tubes being inserted into either limb. Crystallisation, when set up in one limb, travelled round the bend and up into the other, from which crystals were transferred, as before, to a beaker or flask of solution also under the bell-jar.

The three modifications of this form of experiment were tried time after time, and always with the same unvarying result. Solutions which were supersaturated although not perfectly, and therefore less sensitive, were operated upon in this way; but, even with such less favourable circumstances, the normal crystals always started crystallisation in the solution to which they were added.

To ascertain, if possible, whether nuclei, other than crystals of the normal salt, were carried by the tube or its adhering crystals, a capsule of sulphuric acid was placed under the bell. The crust of crystals was, by this means, dried, and became effloresced to a greater or less extent. Now, on lowering them into a supersaturated solution of alum or of magnesian sulphate, they were proved to be inactive.

But such dried normal crystals were active to a solution of sodic sulphate, even after three days' exposure to the sulphuric acid;\* whereas, a solution allowed to evaporate spontaneously on the surface of the tube under cover, forms (modified) crystals, which, as previously related, were found to be inactive. It seems as if the normal crystals become covered with a coating of effloresced anhydrous salt which acts as a protection to the underneath portions, in the same way as oxide of lead does to metallic lead; hence it takes a long time to convert a crystal of the normal salt into the anhydrous by simple exposure to dry air, although it is an exceedingly short operation to perform at temperatures superior to 34° C.

In conclusion, I merely sum up the results of the foregoing experiments.

Any explanation or theoretical considerations are left for a future paper, in which I hope to give the work of other series of experiments now in hand and in projection.

(1.) About 120 experiments were made with thin films, in the manner and with the precautions already detailed, but not a single solution crystallised under their influence.

(2.) Out of 90 odd experiments made with crystals of the normal salt in the manner described, in no single instance did they fail to be active.

London, October, 1870.

#### EVIDENCE CONCERNING THE GERM THEORY OF FERMENTATION

AFFORDED BY THE ACTION OF CERTAIN SUBSTANCES WHEN  
SUSPENDED IN THE AIR.

By ARTHUR ERNEST SANSOM, M.D.

(Concluded from p. 242.)

*Expt. 2.*—It was intended to examine the influence upon vegetable development when various materials prone to present fungoid organisms were subjected coincidentally to the influences of carbolic acid, (a) in the fluid containing the fermentescible matter; (b) in the air alone which was supplied to the materials.

It is necessary to explain that M. Pouchet adduced as evidence, in favour of the theory of spontaneous generation, the development of a peculiar *Aspergillus*, which he himself discovered and named from the circumstances of its formation *Aspergillus primigenius*. Into a flat porcelain dish he poured boiling paste made from wheat-flour, so as to form a layer one centimetre thick. When this began to set he wrote upon its surface with a pencil dipped in a filtered maceration of nut-galls, the words

\* At a future day, I hope to have the results of more experiments upon this point."

GENERATIO SPONTANEA. The dish was then covered with a glass plate, and kept at a mean temperature of 24° C. for four days. At the end of that time the words which had been written appeared in bold relief and of a black colour, owing to the growth of an *Aspergillus* bearing black capsules on cylindric non-articulated stems. The reasoning is thus expressed. The germs of this fungus could not have entered with the paste, for this had fully boiled, and experiment shows that the *Aspergillus* spores are totally disorganised by a temperature below that of boiling water; besides, the spores are too large to have escaped direct observation. They could not have entered with the gall-maceration, because this had been filtered, and microscopic examination demonstrated their absence. They could not have entered with the air, or why should they not have covered the whole surface of the paste and not merely those portions which had been moistened by the gall-maceration? It is scarcely necessary to point out how subsequent investigation has invalidated every one of these positions. But the growth of this fungus presents singular advantages for experimental investigation. Its course of development is regular and uncomplicated, and its prominent characters render it very easy to be recognised.

Upon a layer of flour-paste contained in three flat earthen dishes the following solutions are painted in broad bands:—1. Filtered maceration of nut-galls. 2. Brewer's yeast. 3. Syrup of currants. 4. Claret. The surface of one (B) was washed with 5 drachms of a one per cent

FIG. 1.



*Aspergillus* (seventh day).

In experiment strictly parallel, in atmosphere containing carbolic acid; there was no vegetable growth whatever.

aqueous solution of carbolic acid and then a glass cover was applied. Before a cover was applied to C, a piece of linen imbibing carbolic acid was affixed to it so as to give off the vapour. A, also covered with a glass, was left unchanged.

After two days feathery fungi appeared on the surface of A; B and C remaining, so far as the eye could detect, uninfluenced. On the eighth day the whole were submitted to microscopic examination. The maceration-of-galls band of A presented multitudes of long, jointed filaments bearing on their summits capsules of globular form, containing multitudes of blackish sporules, the *Aspergillus primigenius* of Pouchet. Large spores of the *Aspergillus* were scattered over the whole field, and the capsules were shedding sporules in all directions (see Fig. 1).

The same layer in B (very weak solution of carbolic acid) showed no trace of *Aspergillus*. But it was not destitute of evidence of vegetable organisation and growth. Small spores were seen less than one-fourth the size of those of the *Aspergillus* as well as some penicilliums, mostly short and imperfect, but a few branching.

The same layer in C (vapour of carbolic acid) showed, in nearly its whole extent, no evidence of organisation;



but, at one spot,\* there were seen cellular stems branching, and terminating in globular, oval, or truncated apices, the *Aspergillus polymorphus* (see Fig. 2). The other layers in A presented but little special variations. Feathery penicilliums were seen in almost every spot, the area where the wine was applied chiefly being occupied by round white dots, which proved to be aggregations of minute spherical spores. Penicilliums were abundant everywhere—perhaps chiefly on the surface of the red currant syrup. B and C also showed some minute sporules with penicilliums exceedingly less frequent than in A.

The glass covers were now re-applied, but not luted, so that air freely circulated over all the surfaces. In A, growth proceeded with great rapidity. The generation of *Aspergillus* died, and was succeeded by green mould and fine penicilliums. After a few days, maggots appeared.

On the 23rd day, microscopic examination showed in—  
A (unchanged): Myriads of sporules; dense bands of penicillium fibres; abundant animalculæ.

B (carbolic acid, 1 per cent solution): A few fibres of penicillium; less frequent minute spores; oval cells (*acetic ferment*).

C (carbolic acid vapour): No spores nor fibres, excepting on the yeast-band, which showed abundant yeast-cells unchanged, and just as when first applied to the surface; no growth whatever.

FIG. 2.



*Aspergillus polymorphus*. Drawn by aid of camera lucida.

The chief teaching of this experiment, concerning the action of carbolic acid in very weak solution and in vapour, appears to be the following:—

As regards the development of the specific fungus, *Aspergillus primigenius*: Complete prevention in both cases.

As regards the development of the fungoid organisms: Very marked repression, but not complete prevention in all cases.

Comparative action of (1) weak solution of carbolic acid in direct contact with materials for developing fungoid organisms, and (2) carbolic acid present in the air supplied to such materials: The latter by far the more powerful means of repression.

*Expt. 3.*—The materials were prepared for the development of the *Aspergillus primigenius*, and the measures were repeated with more stringent precautions against the entry of non-carbolised air.

The boiling paste having been poured into a flat dish, two glass covers—the one containing, in its interior, a small quantity of carbolic acid, dropped from crystals melted by heat, and allowed to solidify at the upper part of the glass, the other untouched—were taken; these were then inverted over and imbedded in the paste, and placed aside in a warm place. At the end of six days the results were observed.

Beneath the glass cover containing the carbolic acid (which, of course, could only have acted, by reason of its

volatility, upon the contained air) there was no evidence of any organism whatever. Careful examination showed only minute granules, which aqueous solution of iodine coloured violet, and which were no doubt starch.

Beneath the glass cover containing no carbolic acid, there was exuberant growth of *Aspergillus*, filling up the whole space between paste and glass, its black capsules seen by the thousand, and its spores scattered in all directions.

This was many times repeated with always the same result.

The conclusion may be briefly summarised—

Atmosphere supplied to prepared soil { A, containing no carbolic acid.  
B, containing carbolic acid.

Result { A, abundant vegetation.  
B, no vegetation.

*Expt. 4.*—It seemed advisable to compare the action upon the air of various volatile media and chemical bodies under precisely similar conditions. The paste and gill-maceration were prepared, and over it, within precisely similar glass covers, the agents hereafter named were suspended. The results are expressed in a tabular form. The order expresses the restrictive power over the appearance of fungoid organisms possessed by the various agents, from the feeblest to the strongest.

Order.	Agent employed.	Appearances on fifth day.	Subsequent appearances, air being admitted.
1.	Air unaltered.	Abundant growth of black capsules, <i>Aspergillus</i> .	<i>Aspergillus</i> completely filled the vessel.
2.	Chloride of lime.	Fibres of penicillium.	This result was unlooked for; for, by an accident, the chloride of lime had actually fallen upon the prepared soil. Yet, in and amongst its particles were developed growing fibres of penicillium.
3.	Sulphurous acid.	—	Soon after exposure to air, abundant and rapid penicillium growth.
	Ammonia.	—	Abundant penicillium growth.
	Ether.	—	Small island of mould appeared, with abundant penicillium; afterwards, a few <i>Aspergilli</i> .
6.	Chloroform.	—	After exposure many days, <i>Aspergilli</i> began slowly to appear.
7.	Camphor.	—	After many days, penicillium slowly developed and gradually covered the surface.
8.	Iodine.	—	—
	Creosote.	—	—
	Phosphorus.	—	—
	Carbolic acid.	—	—

The results of this experiment show that many volatile bodies have the power of preventing the appearance of fungi, when present in the air which surrounds the soil upon which these, under ordinary circumstances, grow luxuriantly. The degree and the persistence of the influence of the various volatile media vary, however, considerably. Some, as ether, sulphurous acid, and ammonia, whilst effectually checking development, while they are actually present in the atmosphere, leave when they are volatilised, or during their volatilisation perhaps, favourable conditions for growth.

Chloroform and camphor leave each a most persistent effect. Some act so persistently that no organism appears at all; that is to say, the paste dries up gradually to a yellowish transparent cake, resembling dry gelatine, and presents no evidence of organisation whatever. For this persistency of effect no agent has been found so powerful as carbolic acid.

There is a further lesson to be learnt from this experi-

\* It was probable that the glass cover had not been perfectly luted at this point, consequently the air was imperfectly charged with carbolic acid vapour.



ment. It appears at least to show that the chemical constitution of a volatile medium affords no indication of its energy in preventing the development of fungi. What agent could be expected more profoundly to alter the chemical atmospheric conditions than chloride of lime? Its power as an oxidiser, and collaterally a deoxidiser of aqueous vapour, requires no comment. Yet it was precisely this that was inferior to *all* the other media, many of which could be shown to exert no perceptible *chemical* influence in restraining the manifestations of vitality. The observation, however, agrees with that of Hallier, who found mycodermis, vegetating fibres, and oidium forms in the presence of chlorides of the alkalies and alkaline earths.

*Expt. 5.*—In some of the experiments before recorded the results seem to show that there was less evidence of organisation in a putrescible fluid when a toxic agent was mingled with the air supplied to it, than when the toxic agent was mingled with the fluid itself. This appeared so important as to require further investigation; for it might have a very strong influence in determining the truth between the two theories. For if the doctrine of spontaneous evolution were true, it would, surely, be more probable that the action of any chemical or poisonous agent in repressing the manifestations of life would be most pronounced when mingled with the particles whence vital evolution was proceeding, and least so when only mingled with the atmosphere with which the fluids were in relation. On the other hand, if the germ theory were true, it would be more likely that there would be less fertility when the repressive agent was absent from the fluid and present in the superincumbent air, as the toxic agency would be directly exerted upon the air-germs.

A series of stoppered glass bottles of two ounces capacity was obtained; to the stoppers of some of them were fixed small pieces of sponge. The bottles were then each one-quarter filled with filtered infusion of turnip. Equal quantities of the agents hereafter named were then in the one instance added to the fluid, and in the other dropped upon the sponge so as to become volatilised into the air contained in the bottle. After seventeen days, during which the unmodified infusion of turnip passed through its various stages of putrescence, developing, first, vibrios and bacteria; secondly, fungus spores; thirdly, branching penicillium, which bore abundant fructification, the infusions were examined with the following results:—

Sulphurous acid (1) in the fluid: Abundant vibrios and bacteria in all parts; at the surface innumerable leptothrix chains and fungoid fibres.

Sulphurous acid (2) in the air: Vibrios and bacteria in fluid; on the surface not a trace of a fungoid spore or organism.

Ammonium hydrate (1) in the fluid: Vibrios and bacteria in fluid; on the surface, mass of density-interlacing penicillium, and multitudes of spores.

Ammonium hydrate (2), in the air: Vibrios and bacteria in the fluid; on the surface, no trace of fungoid organism.

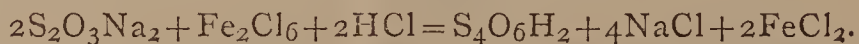
It seems difficult to reconcile these results with any other view than with that of the air-containing fungoid spores, which were killed in the presence of a volatile agent which acted as a direct poison upon it. Vibrios and bacteria, whose germs probably exist intermingled with every drop of the liquid, were alike abundant under both conditions, the poisonous agent being too weak to influence them as it was too weak to influence the fungi which developed when the air did not contain the volatile agent.

From the convergence of many methods of investigation and modes of thought, it seems, therefore, that the germ theory presents the strongest claims for acceptance. It suggests that beyond the confines of the visible world there is probably a world of living things almost inconceivably minute, but possessing varying characteristics. Into this world of beings yet unseen it will be the province of science yet to penetrate.

IMPROVED METHOD FOR THE  
DIRECT QUANTITATIVE ESTIMATION OF IRON  
IN THE STATE OF A PEROXIDE SALT  
BY MEANS OF HYPOSULPHITE OF SODA.

By M. A. C. OUDEMANS, jun.

DR. SCHERER was the first to propose the estimation of iron as peroxide, by means of hyposulphite of soda to be added in aqueous solution to the solution of the ferric iron salt until a violet colouration ceased to be produced.\* Dr. F. Mohr pointed out that this method was inaccurate, inasmuch as that, at the moment the reaction appeared finished, there was already an excess of the hyposulphite of soda added, which cannot be well estimated, because it is decomposed by the free acid of the iron solution, owing to the absolute necessity of applying heat. MM. Kremer and Landolt tried to remedy this defect by the addition of acetate of soda to the iron solution in hydrochloric acid, the effect of which addition would be the setting free of acetic acid, which does not decompose hyposulphite of soda, and made it possible to estimate any excess of that latter salt, after the reduction of the sesquioxide of iron had taken place, by means of a solution of iodine. By a lucky incident, I have found the means of executing the direct estimation of peroxide of iron, in one and the same operation, without the necessity of previous reduction of the iron; and my method leaves nothing to be desired as regards its accuracy. Before I describe this method, I will pay some attention to the reaction of hyposulphite of soda upon a solution of sesquioxide of iron containing free hydrochloric acid. Hyposulphite of soda is readily decomposed by all mineral acids, even when they are largely diluted; and there is no difference in this respect, whether the acid be poured into the saline solution or the latter into the acid. But, when hydrochloric acid is added to a not too concentrated solution of a persalt of iron, and there is next cautiously added to that solution a solution of hyposulphite of soda, care being taken to avoid an excess of the latter, no sulphurous acid is given off; neither is any sulphur precipitated when the operation is conducted in the cold, since the hyposulphurous acid is, under these conditions, converted into tetrathionic acid—



When some chloride of barium is added to a solution of perchloride of iron thus reduced, it is easy to see that not a trace even of sulphuric acid is formed. It is true that, when the fluid before alluded to is boiled, even if it contains no excess of hyposulphite of soda at all, the free tetrathionic acid is decomposed, and that chloride of barium will detect sulphuric acid; but the ensuing precipitate of sulphate of baryta is, according to my experience, exceedingly small, and out of all proportion with the total quantity of tetrathionic acid. I have, moreover, found that, even when the liquid is cautiously heated, it is not quite possible to obtain a correct estimation of the quantity of peroxide of iron by means of hyposulphite of soda, sulphocyanide of potassium being used as a reagent to indicate the end of the operation; yet the results I obtained were better than I at first expected, being only about from 2-100ths to 6-100ths too high.

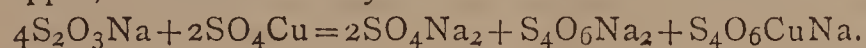
The use of the following method eliminates, I am happy to say, all the defects of this method, which thus becomes available for the correct, ready, and easy estimation of the peroxide of iron in an acid solution:—I add to the iron solution, which may even contain a goodly excess of free chlorhydric acid, one or two drops of a solution of any salt of oxide of copper, and, next, as much of a solution of sulphocyanide of potassium as will suffice for imparting to the iron solution a deep red colour (for this purpose, I take from 2 to 5 c.c. of a solution of this salt at 1 per cent). I next pour from the burette the solution of hyposulphite of soda, whereby it will be seen that the well-known violet

\* *Zeitschr. f. Anal. Chem.*, vol. i., p. 214.



colouration which ensues temporarily when solutions of pure iron and hyposulphite of soda come into contact does not, in this instance, make its appearance; but the red colouration, due to the sulphocyanide, gradually fades away by the addition of the hyposulphite (this decolouration is especially very marked where the liquids meet each other.) At first, the addition of the hyposulphite of soda solution may be made freely; but, when a certain quantity of that fluid has been added (care being taken to stir the iron solution well), it is necessary to add the hyposulphite drop by drop, and to wait a few seconds before a drop more is added. With a little practice, the operator soon learns when the end of the operation is about to be reached. At last, the liquid becomes as colourless as pure water, provided not too much of the copper solution has been added. The iron solution may be heated to 40°, not only without any danger, but with the decided advantage of accelerating the reaction, especially towards the end of the operation, which, however, whether heat be applied or not, can be performed in a few minutes.

The copper salt is to be considered as the cause of the reduction of the iron, it being my opinion that the reducing action of the hyposulphite of soda is first exercised upon the salt of copper, which, in its turn, reacts upon the iron salt; and the former appears to undergo, alternately, reduction and oxidation, and thus to aid the reaction and to play a somewhat catalytic part. The quantity of copper salt required is very small indeed, because I have seen even that so small a quantity as  $\frac{1}{4}$  of a milligram of crystallised sulphate of copper exerts a marked effect; I also found that other substances, among them nitric acid, exert an analogous action, but also disturb the regularity of the process. When the iron solution has become quite colourless, the cupric salt is, in its turn, permanently reduced to a cuprous salt; and, if the cupric salt were not added in too small quantity, there is, after awhile, a whitish precipitate of subsulphocyanide of copper formed. I am not aware (and, therefore, call attention to this *en passant*) whether anyone has pointed out how the reduction of cupric to cuprous salts is brought about by hyposulphite of soda. My experience has taught me that, by this reduction, tetrathionic acid is also formed; and if I admit, as is done by most chemists, the formation of a double hyposulphite of soda and of suboxide of copper, this reaction may be formulated as follows:—



Returning to our subject, I state, in the first place, that my large experience has proved to me that the use of the sulphocyanide of potassium as an indicator is, notwithstanding all that has been alleged against its use in this process by M. Mohr, perfectly safe, and not in the least inconvenient. As regards the concentration of the iron solution and the quantity of free acid, the operator has a great latitude in this mode of operation, but it will be clear that too great excesses are to be avoided. As regards the accuracy of this method, I shall communicate some results, but desire to observe, first, yet, that the estimation of iron by this method is not interfered with by the presence of the salts of alkalis, strontian, lime, magnesia, protoxide of manganese, and alumina; neither do the salts of nickel, cobalt, or copper interfere, provided they are not present in so large a quantity as to become a hindrance by the colours they might impart to the iron solution. The test solution of hyposulphite of soda (at 1-10th of normal standard) I prepared by dissolving 24.8 grms. of the perfectly pure salt in 1 litre of water, taking care to test this solution repeatedly with re-sublimed iodine. I also dissolved 24.1 grms. of iron and ammonia-alum in 500 c.c. of water, and added some c.c. of concentrated hydrochloric acid. Each c.c. of this solution ought to correspond to 1 c.c. of the solution of hyposulphite of soda. I found—

Iron solution.	$\text{S}_2\text{O}_3\text{Na}_2$ .	Iron solution.	$\text{S}_2\text{O}_3\text{Na}_2$ .
10 c.c. =	10.0 c.c.	100 c.c. =	100.50 c.c.
40 „ =	40.0 „	25 „ =	24.95 „
20 „ =	19.9 „	25 „ =	25.00 „

I dissolved 5.6168 grms. of fine piano iron wire in hydrochloric acid, to which some chlorate of potassa was added; the liquid was boiled a sufficiently long time to decompose any excess of chlorate which might be present, and the bulk of the liquid was next brought to 2 litres. Taking for granted that the metal employed contained 99.7 per cent of pure iron, 2 c.c. of the solution ought to correspond to 1 c.c. of the hyposulphite solution. I found—

Iron solution.	$\text{S}_2\text{O}_3\text{Na}_2$ .
20 c.c. =	10.00 c.c.
40 „ =	20.05 „
60 „ =	29.95 „
100 „ =	50.10 „
200 „ =	100.05 „

The following experiments were made so as to preclude any preconceived notion about the quantity of iron taken for experiment, care being taken to estimate the quantity of iron only after the end of the assays with the hyposulphite:—3.576 grms. of iron and ammonia-alum were dissolved in water, some hydrochloric acid added, and the solution made up to 300 c.c.; the average result of three assays was, that the quantity of iron,  $\text{Fe}_2\text{O}_3$ , found was 0.5932, and the quantity calculated 0.5934. In another experiment of the same kind, with 4.0200 grms. of the same salt, also made up to 300 c.c. solution, the quantity of iron found was 0.6656, and the calculated quantity 0.6672. 2.6055 grms. of the same salt, treated as above mentioned, and made up to a solution of 250 c.c., gave, as result, 0.4300 of  $\text{Fe}_2\text{O}_3$  found, and 0.4325 of the same calculated. 0.4980 grms. of fine piano-wire were dissolved as already stated, in chlorhydric acid, and the liquid made up to 300 c.c. 100 c.c. of this solution required, for three assays, respectively, 29.8, 29.6, and 29.6 c.c.  $\text{S}_2\text{O}_3\text{Na}_2$ ; the quantity of iron, Fe, found amounted, on average of the three experiments, to 0.4985, while the quantity calculated (taking the wire to contain 99.7 per cent of metal) amounts to 0.4965.

*Influence of the Degree of Dilution.*—25 c.c. of standard solution of  $\text{Fe}_2\text{Cl}_6$  at 1-10th normal required 25 c.c.  $\text{S}_2\text{O}_3\text{Na}_2$  at 1-10th normal; 25 c.c. of the same solution of iron, diluted with 50 c.c. of water, required 25.05 c.c. of the same hyposulphite solution; 10 c.c. of the iron and 100 c.c. of water required 10.0 c.c. of the hyposulphite solution. (Under these conditions, the experiments require more time.) In order to test whether a more concentrated solution presented any difficulties, the following experiments were made:—I dissolved 0.1953 grms. of piano-wire in hydrochloric acid, added chlorate of potassa, well acidified the fluid, boiled, and made up with water to 20 c.c. I next added the hyposulphite standard solution, of which I used 34.9 c.c., giving as result, Fe—found, 0.1946; calculated (at 99.7 per cent, as above), 0.1954. 3.3680 grms. of sulphate of iron and ammonia (ammonia-alum) were dissolved in a small quantity of water, and the iron oxidised with chlorate of potassa; HCl was next added in excess, and the liquid boiled, and afterwards made up to 150 c.c. The quantity of standard hyposulphite solution required was 85.7 c.c. iron, Fe—found, 0.4799; calculated, 0.4811.

*Influence of the Free Hydrochloric Acid.*—25 c.c. of the  $\text{Fe}_2\text{Cl}_6$  standard solution at 1-10th normal and 1 c.c. of strong HCl required 25.0 c.c.  $\text{S}_2\text{O}_3\text{Na}_2$ .

Same iron solution.	Strong HCl.	Hyposulphite solution (standard).
c.c.	c.c.	c.c.
25 and	2	required 25.0
25 „	3	„ 25.0
25 „	4	„ 25.2
25 „	5	„ 25.0
25 „	6	„ 25.1
25 „	8	„ 26.1
25 „	10	„ 26.2
25 „	15	„ 26.5

[NOTE.—We must not neglect to state here that, according to M. O. Popp (*Zeitschrift für Chemie von*



*Beilstein*, No. 11, 1870), the addition of a few drops of a solution of a salt of copper, as directed by the author of the paper above mentioned, is unnecessary, M. Popp having found that the reaction and operation succeed perfectly if the iron solution is heated to 40° without any addition of a salt of copper.—*Ed. C. N.*]

## ON FERMENTATION.\*

By Professor A. W. WILLIAMSON F.R.S.

(Continued from p. 248).

### LECTURE I.

I OUGHT, however, in justice to the wonderful process which I alluded to, to give you two or three other particulars regarding it. I showed that sugar is broken up by the ferment into these products, but no case is known of pure sugar—and when I say pure sugar, I mean sugar in the purest form in which we have it—being decomposed by yeast. If you were to put some ready-made yeast—thriving, growing, yeast—into a solution of chemically pure sugar, some of your yeast would decompose, some of it would resolve itself into other products, and other parts of it would be absorbing those products which are present in the liquid, and whenever the process is to be carried on advantageously and rapidly, it is customary to add some saccharine liquid—some other substance capable of nourishing the yeast. When I want good fermentation I do not take water to dissolve my sugar, and put yeast into it, but I boil some of this malt, which is one of the best materials for the purpose, in water, and take a decoction of malt, or decoction of yeast, and put the sugar into it. In such a liquid there are several bodies which we know; and I may safely say that there are a great many others which we do not know, and there is no doubt that their presence is of considerable importance to the chemical change which takes place. There are substances which I shall presently have occasion to show you and to speak of, formed by the germination of the grain, by the formation of the malt, which are related somewhat to this body which I have here. This was some pure wheat flour—every kind of flour would not do—and it is supposed that some people mix other materials with flour. It was kneaded up with water, pressed together, and, whilst the pressure was being continued, water was allowed to trickle over it. I have in another bottle some of the water that flowed over it. There is a white substance deposited from this water, which is commonly known and much used by the name of starch, and starch is, in its chemical composition, first cousin to sugar; it is a substance which passes over very readily into a kind of sugar by a process I shall presently have occasion to allude to. But the little ball of flour while being kneaded had the starch washed away from it, and I have left, as the result, a substance which is commonly known by the name of gluten. If I were to describe it in chemical language, I should say it is something like flesh, or the muscular fibre of animals, for, in chemical composition, it approaches very nearly to that. When barley is malted, and kept in a warm place for some time, the grains begin to germinate and decompose, and some bodies are formed from this gluten, which is partially broken up. The malt contains also some sugar made from that starch—grape sugar, as we usually call it.

If we had only those extreme cases, I really do not know what we should do. If we had in our science one set of bodies which appeared so constantly to act at variance with the general laws which the others obey, I think we could not call chemistry a science. I have taken two or three examples to show you the definite proportions which we find to regulate the ordinary process of combination. I might have taken thousands, but the

point is that this law does not appear to apply at all to these chemical changes which we call fermentation. One of the active substances in fermentation is being formed, it is increasing, not disappearing at all, and the contradiction is so strong and manifest that the only way out of the difficulty will be to do something of the kind which I was speaking of some time ago, that is to say, see if we cannot get some intermediate facts which will serve to connect the extreme ones; to see if we cannot get at first something between the two classes, and then try to get some further links between them. There are processes of chemical change—I will not call them processes of fermentation, for I do not know whether they are, but which are analogous to it, and some of them are very interesting and very beautiful. I have here a substance called amygdalin, made from bitter almonds. It is a bitter tasting substance, and consists of four elements which it is not necessary that I should name. In this other bottle I have a paste formed of sweet almonds, which have been crushed with a pestle and mortar, and I will put some of it into the warm distilled water in this flask. Into the mixture I will put some of this amygdalin. If I were to leave it without that addition, there would be very little change; the substance would gradually subside, but there would be no product given off in the way you will presently see. After letting it stand for a few minutes, I will pour some of the mixture into an open vessel, and we shall be able, without difficulty, to perceive a fragrant smell, which is due to the presence of a liquid of which I have a quantity here, a substance known by the name of oil of bitter almonds. If we were to perform the same experiment on a large scale, and macerate some of this amygdalin with almond paste, put them together with warm water, distil the mixture, and collect what comes over, we should find that water would pass over, and with it would be a few drops of oil of bitter almonds, and the amygdalin would be decomposed in the process. There is in the sweet almond paste a substance which I cannot describe in better terms than by comparing it to that gluten which I showed you just now. It is very similar to it in its composition, and by the contact of this, the synaptase, as it is called, with the amygdalin the elements of the amygdalin are broken up into several products; one of them is the oil of bitter almonds, another is prussic acid, which generally accompanies the oil, the third is a variety of sugar of the kind which is called grape-sugar, and there is probably also some formic acid. Here we have the breaking up of a complex body, amygdalin, into several simpler bodies by the action of the body called synaptase; but there is not in the process, as far as I know, any living organism at work. There is a substance which is somewhat similar to these living organisms, but there is no organised structure, as far as our knowledge goes at present.

Take another experiment. I have here something which is not a *blanc mange*, although it looks something like it; it was made by boiling potato starch with water. We let it cool, and then turned it out; some was put into a flask with two or three ounces of crushed malt. It was warmed to a temperature of 60° C. for about an hour; there was no boiling. The substance was then squeezed through a cloth to keep back the husks of the malt, and here is the liquid which ran through. It is perfectly liquid, and its consistency is entirely different from that of starch, from which it was made; it is quite sweet to the taste, and there is a large quantity of sugar in it. There is also another body which we class with the sugars; that is, there is in this liquid a good deal of a kind of gum, which we call dextrine, which would easily pass into sugar. The starch, when it was being converted by the action of the malt into those soluble bodies, did not, so far as we know, break up into simpler substances; the process was of a different kind. It assimilated the water—the starch combined with the water, and at the same time divided itself, some of it forming one and some the other product. Here, also, there was not, as far as my know-

\* The Cantor Lectures. Delivered before the Society of Arts.



ledge goes, any ferment, or any organised cells in the liquid. If they were present it was an accident, and was not essential to the change which took place. I am the more confident in saying that no ferment was there present, for we can get, and we very often do get, precisely the same formation of starch without any malt at all. If, instead of warming some of that starch with the infusion of malt, I had mixed it with a little—about 5 per cent—of that strong sulphuric acid, and had heated it, it would have been dissolved almost like sugar in water. In fact, there are now in Germany, and also in England, manufactories in which starch is converted by the action of dilute sulphuric acid, into grape-sugar, and the same change which we get by organic substances—that is the point—we also get by the action of this mineral acid.

Another change of the same kind I may mention, especially as the subject of it is in itself interesting. I have here a substance which people have been accused of making for the purpose of adulterating quinine. It is made from willow bark, and is believed to possess febrifuge qualities, so that there was some little excuse for what I have mentioned. This substance is called salicine, and when heated with dilute sulphuric acid, in the same way as the starch when so heated, was converted into sugar and dextrine; this salicine breaks up in a way which I might compare with that in which some bodies are broken up by fermentation.

Another case of same kind is afforded by tannin, a substance extracted from gall nuts, and which is present in oak and many other barks. It is used for combining with gelatine, which is the principal constituent in hides, to form leather. If we dissolve this tannin in water, and leave it in an open vessel, it will get mouldy; and if you examined it a some time you would find none of it left. It would all disappear, just like sugar in the process of fermentation, and in place of it you would find, in that particular process, a body which you might easily crystallise out from the liquid, and which I have here; it is called gallic acid. It is a body resembling tannin in some respects, for instance, in the property of forming, in combination with iron, a dark substance, which is used in suspension in water, for writing ink. But it will not do to form leather in combination with gelatine. If you left the tannin in an open vessel, it would decompose, and there would be left gallic acid, and some other material which was formed at the same time would have disappeared. By boiling tannin with dilute acid, we get the process performed more regularly. Upon boiling some tannin with dilute sulphuric acid, you would find that water would be taken up by it, the tannin would combine with water, and it would break up into sugar and gallic acid, the process being exactly like that which I mentioned in the case of salicine. There is a most direct analogy between the process of breaking up which sulphuric acid effects upon tannin and that of fermentation. I ought to say, when telling you of the decomposition of the tannin, that it is effected by little animal organisms present in the liquid, and it appears that they are the agents of the transformation.

(To be continued).

## ON THE PRECIPITATION OF ANTIMONOUS SULPHIDE FROM BOILING SOLUTIONS.

By STEPHEN P. SHARPLES.

In the precipitation of antimonous sulphide, I have found it of very great advantage to employ the following process:—Into the solution, containing, as usual, tartaric and free chlorhydric acid, a current of sulphydric acid gas is to be passed, the liquid being, during the passage of the gas, gradually heated to the boiling-point. The boiling is then to be continued for fifteen or twenty minutes, the current

of gas passing uninterruptedly until the voluminous sulphide has become a dense granular powder occupying but a small portion of the original volume of the sulphide. The sulphide may then be washed with great facility, and dried upon a sand filter at 200°—300° C. All the determinations of antimony made in the laboratory of the Lawrence Scientific School for some years have been executed in this manner, the results leaving nothing to be desired. Arsenious sulphide does not become granular and dense under the same circumstances. In this connection, I may be permitted to mention that the sulphides of nickel and cobalt, when precipitated from boiling solutions in the manner recommended by Professor Gibbs some years since, should be filtered off, and washed immediately after precipitation. In this manner, there is no oxidation upon the filter, even during the drying of the precipitate. But, if the sulphides are allowed to stand in the solution from which they have been precipitated, for even a few hours, they will usually oxidise upon the filter during the washing.—*American Journal of Science.*

## PROCEEDINGS OF SOCIETIES.

### CHEMICAL SOCIETY.

Thursday, November 17th, 1870.

Professor WILLIAMSON, F.R.S., President, in the Chair.

THE following papers were read:—

“*Mineralogical Notices*,” by Prof. MASKELYNE and Dr. FLIGHT. The contents of this communication were:—

1. *On the Formation of Basic Cupric Sulphate*.—In 1867, M. Pisani described a mineral which he supposed to be the Woodwardite of Mr. Church. The substance, however, is not the latter mineral. It had previously been examined in the Laboratory of the British Museum, and the results sufficiently tallied with those of M. Pisani to identify the mineral. It can be divided into an inner layer and an outer crust. The first consists of—

Copper oxide .. .. .	24.561
Alumina .. .. .	23.063
Calcium oxide .. .. .	0.086
Magnesium oxide .. .. .	0.749
Sulphuric anhydride .. .. .	6.775
Silicic anhydride .. .. .	6.689
Water .. .. .	38.528
	<hr/>
	100.451

The crust is thus composed—

Copper oxide .. .. .	10.255
Alumina .. .. .	27.250
Calcium oxide .. .. .	1.403
Magnesium oxide .. .. .	6.183
Sodium oxide .. .. .	0.643
Sulphuric anhydride .. .. .	2.438
Silicic anhydride .. .. .	7.530
Carbonic anhydride .. .. .	0.528
Water .. .. .	43.969
	<hr/>
	100.199

These numbers give us but little insight into the constitution of the mixed minerals. The only interest they offer is in the light they seem to throw on the possible modes of the formation of native basic cupric sulphates. The actions of solutions of magnesium or calcium sulphate on malachite may terminate in the production of Langite. An experiment in the Laboratory showed that an insoluble cupric sulphate and acid magnesium carbonate were actually formed.

2. *Opal from Waddela Plain, Abyssinia*.—Mr. Markham presented to the British Museum some remarkable speci-

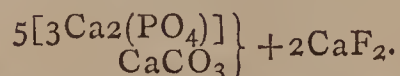


mens of green opal from the above locality. Its analysis yielded the following numbers:—

Silicic acid (soluble) .. ..	90.562
Silicic acid (insoluble) .. ..	2.049
Water .. ..	5.656
Iron peroxide .. ..	0.933
Manganese peroxide .. ..	trace
Calcium oxide .. ..	0.137
Magnesium oxide .. ..	0.311

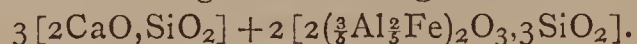
100.648

3. *Francolite, Cornwall*.—Its analytical numbers point to the formula—



It is, in fact, a fluor-apatite in which one equivalent in every six of the calcium phosphate is replaced by carbonate. The crystallography of this mineral seems also to point to its not being ordinary apatite, and, in fact, to its not being the same mineral as the original Francolite from Wheal Franco.

4. *Epidote and Serpentine, Iona*.—A pebble, in which a green mineral traverses bright red felspar and quartz in veins, was sent by the Duke of Argyll to the British Museum. Its analysis leads to the view that it consists of a lime epidote with some 23 per cent of quartz, the former mineral having the following constitution:—



Two specimens of serpentine, of the same locality, gave the general formula—



where R represents, in one case, Mg with a little Fe and Ca; in the other, Mg with nearly one-fifth of its equivalent of an equal mixture of Fe and Mg.

5. *Vivianite*.—Two kinds of this mineral were found in an unknown Cornish locality. The one, of a pale blueish tint was ascertained to consist of—

Iron protoxide .. ..	42.709
Iron peroxide .. ..	1.126
Phosphoric anhydride .. ..	28.526
Water .. ..	28.984

101.345

The other variety, of a brownish colour, gave on analysis—

Iron protoxide .. ..	42.889
Iron peroxide .. ..	0.801
Phosphoric anhydride .. ..	28.792
Water .. ..	29.433

101.915

Both proved, therefore, to be octahydrated ferrous orthophosphate,  $3\text{FeO} \cdot \text{P}_2\text{O}_5 \cdot 8\text{H}_2\text{O}$ , and the difference in the colours can only be ascribed to some minute difference in the degree of oxidation of the iron. The brown variety was enclosed in nodules of a dark blue earthy mass which was composed of:—

Iron protoxide .. ..	37.214
Iron peroxide .. ..	9.169
Phosphoric anhydride .. ..	23.897
Carbonic anhydride .. ..	5.162
Water .. ..	23.871
Silica .. ..	0.811
Organic matter .. ..	0.826

100.920

These numbers may be interpreted as representing 5 equivalents of octahydrated ferrous orthophosphate with 1 equivalent of octahydrated diferric phosphate, mixed with four equivalents of ferrous carbonate. The British Museum possesses some fine crystals of vivianite from Fernando Po, the chemical examination of which gave as results:

Iron protoxide .. ..	38.501
Iron peroxide .. ..	5.083
Phosphoric anhydride .. ..	27.802
Water .. ..	28.326

99.712

This specimen stands intermediate between the blue and brown crystalline varieties on the one hand, and the blue earthy mineral on the other.

6. *Cronstedtite*.—The analysis of this mineral presented considerable difficulties, inasmuch as it was extremely difficult to free it from the substances associated with which it is found.

The cronstedtite in question possesses an unusual interest from a crystallographical point of view, being one of the best defined types of hemimorphism.

7. *Pholerite*.—This mineral, derived from India, is of a pale flesh-white, penetrated in several places by patches and veins of a black mineral. An analysis of the flesh-white mineral gave the following results:—

Silicic acid .. ..	43.144
Aluminium oxide .. ..	41.073
Water .. ..	15.783

100.000

Traces of iron and manganese oxides accompany the alumina. A new name was proposed for this mineral, but the analysis shows it to be nothing but pholerite.

MR. CHURCH observed that it was a matter of congratulation to have those beautiful specimens, which are stored in our magnificent national collections, investigated in so excellent a manner as the contents of the paper just read had shown.

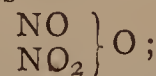
The next communication was a note by MR. CHAPMAN, "*On the Oxides of Nitrogen*."

In a paper read at the last meeting of the Chemical Society, Mr Chapman mentioned that he had quantitatively estimated nitric oxide by converting it into nitric acid and determining the latter by the production and weighing of the baryta salt. Objections were then raised as to the possibility of the completeness of such a conversion. Mr. Chapman now endeavoured to show, by referring to well-known chemical facts, that, whether  $\text{N}_2\text{O}_5$ ,  $\text{N}_2\text{O}_4$ , or  $\text{N}_2\text{O}_3$  be formed when NO is left with excess of oxygen over water, the final result must be the transformation into nitric acid. He, moreover, referred to the circumstance that the above-mentioned facts were accepted by Schloesing, by Playfair, and Wanklyn, as sufficient to found upon them the quantitative estimation of nitric acid. As to  $\text{SO}_2$  being present in his experiments, Mr. Chapman found this by special researches to be of no consequence.

MR. HARCOURT reasserted that, on his passing nitric oxide into oxygen, he obtained, as result, nitric peroxide; when reversing this order, and passing oxygen into nitric oxide, a mixture of  $\text{N}_2\text{O}_4$  and  $\text{N}_2\text{O}_3$  seems to be formed.

Mr Chapman replied that the different results obtained by Mr. Harcourt and by himself were, in all probability, due to differences of the temperatures at which the respective experiments had been executed.

PROFESSOR WILLIAMSON took occasion of this repeated mentioning of nitric peroxide to remark that this compound may be viewed as



i.e., as water in which the one hydrogen was replaced by NO, the other by  $\text{NO}_2$ .

The Society then adjourned to December 1st, when Mr. Perkin will read a paper "*On some Derivatives of Anthracene*."

#### GLASGOW PHILOSOPHICAL SOCIETY: (CHEMICAL SECTION).

THE annual general meeting was held in the Society's rooms, Corporation Buildings, on Monday evening, the



21st inst., at eight o'clock. Mr. W. R. Hutton, Vice-President, in the chair.

Dr. Wallace, F.R.S.E., F.C.S., was unanimously elected President for three years, in room of Professor Anderson, whose term of office has expired.

Mr. John Ferguson, M.A. was appointed a Vice-President in room of Dr. Wallace.

Four new members of Council were elected in place of the four who retired by rotation.

The following is the present list of office-bearers:—

*President*—Dr. Wallace, F.R.S.E., F.C.S.

*Vice-Presidents*—Mr. Alexr. Whitelaw; Mr. W. R. Hutton; Mr. John Ferguson, M.A.

*Members of Council*—Mr. James Anderson; Dr. John Clarke; Mr. James Couper; Mr. John Ferguson, M.A.; Mr. W. R. Hutton; Mr. James Maclear, F.C.S.; Mr. P. M. Moir; Mr. T. L. Patterson, F.C.S.; Mr. E. C. C. Stanford, F.C.S.; Mr. John Sutherland; Mr. R. R. Tatlock, F.R.S.E., F.C.S., *Secretary*; Mr. Alexr. Whitelaw.

### ROYAL IRISH ACADEMY.

THERE was a general meeting of this Society on Monday, the 14th, when the following papers were read:—

I. REV. MAXWELL CLOSE, "*On M. Delaunay's Views Relative to the Condition of the Interior of the Earth*,"

II. SAMUEL FERGUSON, LL.D., "*On the Difficulties Attendant on the Transcription of Ogham Legends, and the means of avoiding them*."

The following recommendation of the Council was also adopted:—

"That Her Majesty's Government be memorialised to use their good offices in order to prevent, as far as possible, any injury during the present siege to the collections in Paris, which are universally acknowledged to be of inestimable value to Science, Literature, and Art."

### LABORATORY NOTES.

#### SUB-PERMANENT MAGNETISM EXPERIMENT.

THE following experiment may be interesting or useful to some of your readers. The object of the experiment is to produce, in a few minutes, what Dr. Tyndall has named sub-permanent magnetism; and thus represent to a class *quickly* what is effected by the earth *slowly* in soft iron lying in the magnetic meridian, and subject to molecular disturbance from percussion or other causes.

The requisites for the experiment are—a block of cast-iron (wrought-iron might, perhaps, do) slightly magnetised, a bit of soft iron wire, a hammer, and a magnetic needle for testing the wire.

*Expt. 1.*—Lay the iron wire on the block, and hammer it lightly from end to end, for a few seconds. Presented to the needle, the wire will be found magnetised, showing distinctly strong N. and S. poles, produced by the S. and N. poles of the block.

*Expt. 2.*—Place the wire *reversed* on the block, *i.e.*, lay the N. pole of the wire on the N. pole of the block, and hammer as before. Tested again by the needle, the wire exhibits its poles reversed.

*Expt. 3.*—Lay the wire as in *Expt. 1.*, and hammer; the original polarity is restored. Finally, by changing the position of the wire, the pole may be changed and re-changed as long as the wire lasts.

This experiment would seem to represent well the magnetising action of the earth. The block personates the earth with its magnetism, which is not less comparatively than that of the cast-iron. Were the wire to remain for a considerable time lying on the block, it would be magnetised. The hammering effects *quickly*, in the whole

wire that molecular disturbance which is slowly and piece by piece produced in great masses of iron standing on the earth.—I am, &c.,

E. KERNAN.

Clongowes.

### CORRESPONDENCE.

#### ATACAMITE.

*To the Editor of the Chemical News.*

SIR,—Under the head of "Notes and Queries," in your last week's impression, atacamite is mentioned as a "rare mineral; new to Britain." This is an oversight, as you will be quite well aware that it has long been found at St. Just, Cornwall, and that its variety, Botallackite, is only known as a product of the Botallack mine in that county.—I am, &c.,

THOS. C. ARCHER.

Edinburgh Museum of Science and Art,  
Nov. 22nd, 1870.

#### THE RECENT DISCUSSION AT THE CHEMICAL SOCIETY.

*To the Editor of the Chemical News.*

SIR,—Although there was no doubt that nitric oxide in presence of an excess of oxygen, and of much water, and at moderate temperatures, passes totally into nitric acid, still, the recent discussion at the Chemical Society is hardly to be regretted. If it did not throw any light upon the scientific question—if the fact of such a change taking place was manifest to any one who consulted the common chemical text-books, and still more patent to those who had experimented for themselves—it, at any rate, was calculated to illustrate the curious incompleteness of our chemical education; or, perhaps, I ought to say, it illustrates the necessity of investigating some of the commonest and most elementary of chemical facts that have, somehow or other, been lost sight of.

In my eyes, criticism is one of the paramount needs of chemistry. One false fact, stubbornly maintained, is capable of closing the way to those generalisations which are the glory of science, and the sweeping away of one such false fact is, usually, a far greater service than the correct observation of a new one.—I am, &c.,

J. ALFRED WANKLYN.

#### PURIFICATION OF SYRUPS.

*To the Editor of the Chemical News.*

SIR,—I regret to have to trouble you with the following remarks, but I consider it a duty to do so.

You have published, in the last number of your interesting and valuable journal, a notice on a patent, taken by Dr. Seyferth, for the purification of syrups and molasses in the manufacture of sugar by a sulphurous acid solution.

I beg to state that I carried out the application of this acid in sugar refining so far back as 1850, and sold it to some sugar refiners, who employed it successfully to my knowledge, and no doubt are doing so at the present time.

Dr. Seyferth will find a notice of my process in the *Technologie*, vol. xix., p. 478 (1858), and in the *Chemist*, vol. v., p. 344 (1858). There, it is stated that the application of sulphurous acid possesses two marked advantages for the sugar refiner—(1) "That it stops the fermentation of his hot liquors as they come out of the char-filters; and (2), when properly applied, it tends to prevent the



re-colouration of the liquors during their concentration in the vacuum-pan. In practice, I found that very successful results were obtained by adding 2 gallons of a saturated solution of sulphurous acid to 100 gallons of decolourised liquor as it left the char-filter, and was collected in tanks until pumped up or run into the vacuum-pan.'

In the same volume (same page), I also described a very simple and cheap mode of preparing hundreds of gallons (per day) of sulphurous acid.—I am, &c.,

F. CRACE CALVERT.

Royal Institution, Manchester.

## MISCELLANEOUS.

**Royal Institution of Great Britain.**—The courses of lectures before Easter include eleven lectures by Dr. Odling, F.R.S., on "Davy's Discoveries in Chemistry;" four lectures by W. H. Channing "On the Progress of Civilisation;" three lectures by Professor Jowett, M.A., "On Socrates," and four lectures by H. O'Neill, R.A., "On the Spirit of the Age." Friday evening discourses, which commence on January 20th, 1871, are expected from Dr. Tyndall, Dr. Odling, Mr. E. J. Reed, Mr. James N. Douglass, Dr. Carpenter, Captain Noble, Professor Clerk Maxwell, Mr. J. N. Lockyer, Mr. W. Mattieu Williams, and Professor Max Müller.

**Permanganate of Potassa against Coryza.**—Although not exactly belonging to the subject matter usually treated in this paper, we think we may briefly call attention to the use of permanganate of potassa in very dilute solution (0.18 grms. = 1.67 grains to 60 grms. or c.c. = to about 2 fluid ounces) against coryza, cold in the head, attended with severe sneezing. Of the permanganate solution, some 20 to 60 drops are poured into a tumbler-full of water, and of this liquid every two hours a quantity of a table-spoonful is snuffed up the nostrils, and if there be any soreness of the throat, the same liquid is applied as a gargle. Dr. Franck, of Munich, states that he has prescribed this mode of treatment now for some years, and found it very efficient by curing the complaint in about from two to four days.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

*Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

**NOTE.** All degrees of temperature are Centigrade, unless otherwise expressed.

*Neues Jahrbuch für Pharmacie, von Dr. F. Vorwerk, September, 1870.*

This number contains the following original papers and memoirs:—

**Chemical Assay of Cements.**—Dr. C. Bender.—This memoir has been written with the view of enabling parties somewhat acquainted with chemistry, but not professional chemists, to perform an analysis of cements—viz., so-called Portland and Roman cements. As an introduction, the paper gives a lengthy description of the physical qualities of cements; but it is clear (except that Portland cement of good quality exhibits, when seen under the microscope, a foliated structure, and that a yellowish brown colour is an indication of adulteration), that the outward aspect, specific gravity, and other properties of these substances must of necessity vary with the mode and materials of preparation. The chemical analysis is conducted in the following manner:—A quantity of from 1 to 3 or 5 grms. (according to the author, the quantity to be taken depends upon the accuracy of the balance the operator has at hand; but it is understood, at the same time, that the balance should be capable of turning, when loaded in each pan with 30 grms., with at least 1–2 milligrms.) is weighed off, and the hygroscopic water estimated by drying in an air-bath at

180°–200°. The water of constitution, and also the carbonic acid, are estimated by fusing another portion of the cement in a platinum crucible along with about four times its weight of previously fused and pulverised borax; the joint quantity of both these constituents, exclusive of the hygroscopic water, will not, on an average, exceed 3 per cent. For the estimation of the other constituents, a quantity of from 4 to 6 grms. is weighed off, and, after having been put into a beaker, hydrochloric acid, of about 1.104 sp. gr. at 15°, containing 20 per cent of anhydrous acid, and boiling at 110°, is added, and the vessel and contents first heated on a water-bath, and next evaporated to dryness. After the dry residue has been moistened with hydrochloric acid, it is left standing for twelve hours, water added, and filtered off, the residue on the filter being pure silica if the cement is well made. The filtrate and washings are diluted with distilled water to 1000 c.c.; and, of these, 300 c.c. are taken for the estimation of the alumina, oxide of iron, lime, and magnesia. For this purpose, the acid liquid is, first, as near as possible, neutralised with a solution of carbonate of soda; next, a solution of acetate of soda is added, and the liquid boiled, whereby basic acetate of iron and alumina and (in case phosphoric acid were present) phosphate of peroxide of iron are precipitated. This precipitate is collected on a filter, and, after having been washed, dried, ignited, and weighed, the estimation of the other constituents of the cement—viz., phosphoric and sulphuric acids, manganese, lime, magnesia, alkalies, and chlorine, is done by methods fully described in all works on quantitative chemical analysis; but, in addition to the process here alluded to, it is necessary to disintegrate and fuse, by well-known methods, a separately weighed portion with pure carbonate of soda.

**Meteoric Dust among Snow.**—Dr. A. Husemann.—This paper gives an account of a reddish coloured dust which fell along with snow in the Swiss canton Du Vaud in the winter of 1867. According to a calculation, made from experiments and observations conducted with care, the quantity of dust fallen over the entire surface of the canton amounted to about 1500 tons. The author examined the dust, as well as the snow which had fallen simultaneously. The water yielded by the snow contained a considerable quantity of sulphate of lime and organic matter, both of which are absent in ordinary snow-water, at least in Switzerland. The microscopical inspection of the dust proved it to contain minute particles of mica, felspar, quartz, and variously-shaped organic matter. After having been dried at 100°, and ignited, the loss amounted to from 20.8 to even 24 per cent for four different assays. The greater portion of this loss was due to the volatilisation of water of crystallisation and constitution, but nitrogenous organic matter was also found to be present. Of the residue after ignition, about half was found to be soluble in hydrochloric acid. This solution, which was only qualitatively tested, contained peroxide of iron, lime, alumina, magnesia, and sulphuric acid; the portion insoluble in acid, having been fused with a mixture of potassa and soda, was found to contain, beside a large quantity of silica, also alumina, oxide of iron, and lime. The dust, when treated with an acid, gave off carbonic acid largely. The author also quotes an analysis of so-called Orandust—that is to say, a dust carried across the Mediterranean to Europe, that dust being undoubtedly brought by wind from the Sahara Desert. The author found this dust to contain, in 100 parts—Silica, 54.85; carbonate of lime, 20.48; sulphate of lime, 0.41; carbonate of magnesia, 3.95; peroxide of iron, 4.25; alumina, 0.98; water, 2.34; organic matter, 3.90; chloride of sodium, traces. The author observes that this analysis is not complete, being short from 100 by about 8 per cent, this being due to the very small quantity of substance at the disposal of the operator.

**Morphia from the Capita Papaveris Albi.**—Dr. Vorwerk.—The author states that he has for some time past prepared morphia with good success from the almost valueless poppy-heads, which, when first exhausted with water, yield from the extract about 3-10ths per cent of the heads of morphia.

**Alkaloids in Plants belonging to the Family of the Boraginææ.**—Dr. Buchheim.—The author briefly states that, having found it stated that the extract of cynoglossum acts as a poison, in a manner similar to the American arrow poison, known as *curara*, he felt induced to try to extract, from various plants belonging to the family above named, an alkaloid. In this respect, he was only partially successful, by obtaining from the cynoglossum a body which, although not quite pure, exhibited properties which—as, for instance, alkaline reaction, precipitation by tannin, by phospho-molybdic acid, and chloride of mercury—proved it to be a compound akin to an organic alkaloid. This substance, for which the name of cynoglossine is proposed, was found to have a specific poisonous action on various animals.

*Bulletin de l'Académie Royale des Sciences, des Lettres et des Beaux Arts de Belgique, No. 8, 1870.*

This number only contains the following paper relating to physico-chemical and allied sciences:—

**Researches on the Constitution of Phloretic Acid and on Sulpho-Hydrocinnamic Acid.**—L. L. de Koninck.—In the first portion of this essay the author gives an account of his researches made for the purpose of verifying, experimentally, the hypothesis of MM. Glaser and Buchanan, who view phloretic acid as being normal ortho-oxyphenyl-propionic acid; but the author's experiments have not led to any direct result in this direction. The second part of this paper treats on sulpho-hydrocinnamic acid, which is prepared by dissolving hydrocinnamic acid in a mixture of strong sulphuric and fuming sulphuric acids, and heating to 125° for about an hour's time. The liquid is then poured into a rather large quantity of water; the hydrocinnamic acid which has not been converted into sulpho acid falls down as an oily liquid, which, after the fluid has become quite cold separates as a crystalline mass. The sulpho-hydrocinnamic acid is obtained pure, in free state, by means of the addition to the fluid, first, of some carbonate of baryta, and next baryta-water; and the hydro-



cinnamate of baryta is next carefully decomposed with just enough dilute sulphuric acid. Sulpho-hydrocinnamic acid thus obtained is a highly deliquescent, solid, crystalline substance. Its hygroscopicity is so great as to prevent its being obtained in sufficiently dry state for organic elementary analysis; but its composition, as deduced from the salts it forms with bases, is  $C_9H_9SO_5$ . The author describes the following salts of sulpho-hydrocinnamic acid:—Acid sulpho-hydrocinnamate of potassium,  $C_9H_9.KSO_5$ , obtained by carefully precipitating a solution of acid sulpho-hydrocinnamate of barium with neutral sulphate of potassa; the addition of alcohol to the aqueous fluid causes the precipitation of the compound potassa salt just named, which does not contain any water of crystallisation, and was, on analysis, found to contain 14.58 per cent of potassium. Neutral sulpho-hydrocinnamate of potassium,  $2C_9H_9.K_2SO_5 + H_2O$ , obtained by neutralising a solution of the preceding salt.—This neutral salt crystallises in clinorhombic, prismatic-shaped crystals, from its concentrated solution in dilute alcohol; the salt contains 2.86 per cent of water, and 24.77 per cent of potassium. Neutral sulpho-hydrocinnamate of ammonium,  $C_9H_9SO_5.2NH_3 + H_2O$ , obtained by dissolving the sulpho-hydrocinnamic acid in an excess of ammonia.—The salt crystallises spontaneously, but is obtained in more beautifully crystalline state by the addition of absolute alcohol to a warm and concentrated aqueous solution of the salt, which, in its anhydrous state, contains 12.88 per cent of ammonia. Acid sulpho-hydrocinnamate of barium—



crystallises most readily from a solution which contains a slight excess of the sulpho-hydrocinnamic acid.—The per cental composition of this salt is—Carbon, 33.29; hydrogen, 3.70; barium, 21.11; sulphur, 9.86; water, 8.32; oxygen, 23.72. Neutral sulphohydrocinnamate of baryta,  $C_9H_9BaSO_5 + H_2O$ , obtained by adding to a solution of the acid baryta salt a slight excess of hydrate of baryta; that excess is first removed by a current of carbonic acid, and, after filtration, the liquid deposits, by spontaneous evaporation, or by being heated on a water-bath, a white-coloured crust, of a non-crystalline mass. The salt contains 4.70 per cent of water and 37.57 per cent of barium. Acid sulpho-hydrocinnamate of cadmium,  $C_{18}H_{18}CdS_2O_{10} + 4H_2O$ , contains 17.45 per cent of cadmium. Neutral sulpho-hydrocinnamate of silver,  $C_9H_9Ag_2SO_5$ , a crystalline salt containing 48.43 per cent of silver. Acid sulpho-hydrocinnamate of copper,  $C_{18}H_{18}CuS_2O_{10} + 4H_2O$ .—When a solution of the acid sulpho-hydrocinnamate of baryta is carefully precipitated with a solution of sulphate of copper, a green-coloured liquor is formed, which, on being concentrated, deposits a crystalline apple-green coloured salt, and a pale blue-coloured amorphous substance, which is the basic copper salt. The neutral salt contains 12.13 per cent of water, and in dry state, 12.06 per cent of copper. The formula of the basic copper salt is  $C_{18}H_{18}Cu_3S_2O_{12} + 3H_2O$ .

*Berichte der Deutschen Chemischen Gesellschaft zu Berlin*, No. 15, 1870.

This number contains the following original papers and memoirs:—

**Contribution to the History of the Nitriles.**—Dr. A. W. Hofmann.—After quoting a portion of a paper published by the author in the *Comptes Rendus* for September 9th, 1867, he proceeds to state—Isocyanamyl and cupronitrile appear to be the ends of a chain of isomeric bodies, between which there must exist a lengthy series of other bodies which have to be formed by the dehydration of butylamine acetate, propylamine propionate, ethylamine butyrate, and methylamine valerate. The paper contains, next, a series of lengthy formulæ; and the author further proceeds to say that anhydrous phosphoric acid, which acts violently on ammoniacal salts, also causes considerable decomposition when allowed to act upon the salts of the primary monamines; it might, therefore, be preferable to act upon the corresponding monaminamides.

**Beryllium Platino-Chloride.**—J. Thomsen.—Beryllium platino-chloride is very readily soluble in water, crystallises very easily, is deliquescent, but not altered when exposed to dry air. When rapidly crystallised, it forms an orange-coloured crystalline powder; when slowly crystallised, it forms short prismatically-shaped crystals. The composition of this salt is  $PtCl_4 + BeCl_2 + 9H_2O$ . Heated to  $120^\circ$ , the salt loses five molecules of water, while the rest of that fluid is not even driven off at  $200^\circ$ ; the composition of the dry salt is, therefore,  $PtCl_4 + BeCl_2 + 4H_2O$ .

**Alleged Derivation of the Law of Avogadro from the Mechanical Theory of Heat.**—J. Thomsen.

**Relation of Chemistry to Mineralogy.**—Dr. C. Rammelsberg.—This paper, a lecture, is reserved for full translation.

**Alloy of Lead with Platinum.**—A. Bauer.—After referring to the observation of M. Deville, that an alloy of lead and platinum is readily decomposed in consequence of the conversion of the lead into white-lead, the author made an alloy, consisting of 3 parts of pure lead and 1 part of platinum. This alloy is so brittle that it can be readily pulverised; and the powder so obtained was moistened with water, and placed under a bell-jar exposed to the action of carbonic acid, oxygen, and vapours of acetic acid. The conversion of the lead into white-lead took place rapidly; and, after it appeared that all the lead was converted into white-lead, the powder was treated with acetic acid, and the residue again exposed under the bell-jar to the action of the same substances. This process having been repeated several times, there remained at last a steel-greyish coloured crystalline powder, which only appeared to be finely-divided platinum. On being treated, however, with dilute nitric acid, the author found that the powder consisted of an alloy of lead and platinum, which contained, in 100 parts—Platinum, 48.82; lead, 51.18; corresponding to the formula  $Pt + Pb$ . This alloy has a sp. gr. of 15.77, is readily decomposed by mineral acids, but withstands boiling with acetic acid when rapidly

fused it is, after cooling, a bismuth-like, crystalline, very brittle metallic mass. The alloy, submitted in a muffle to the process of oxidising ignition, fuses, the lead is driven off, and platinum left.

This number contains a tabulated form, exhibiting the rules and prescriptions to be observed for disinfection, as drawn up by a committee of the Chemical Society of Berlin, and bearing upon the necessities occasioned by the war.

*Bayerisches Industrie und Gewerbe Blatt*, August, 1870.

This number opens with a lengthy communication, issued by the Bavarian Minister for Trade Manufactures and Home Affairs, concerning the—

**Manufacture, Keeping, Sale, and Transport of Gunpowder, Gun-Cotton, Fireworks, and Detonating or Explosive Materials.**—This communication, based upon Article 169 of the Bavarian Penal and Police Code, proves, in a very high degree, the eminent technical knowledge possessed by the parties by whose care this excellent regulation has been drawn up, so as to ensure perfect safety, yet not to hamper proper freedom of action, by all concerned.

The following original papers and memoirs relating to chemistry and collateral sciences are contained in this number:—

**Fermentation.**—Dr. A. Weinberg.—This very exhaustive memoir, a lecture given before the Chemical Society of Munich, contains a condensed review of all that has been done by scientific men to elucidate the phenomena of fermentation. The author ranges the different investigators of this subject into the following groups:—(1) Those who consider fermentation to be a purely chemical process, the result of the chemical action of the ferment or yeast on the sugar; MM. Trommsdorff and Meissner are the founders of this theory. (2) Those who consider fermentation to be a process of galvanic decomposition called forth by the dualism of the exciting body in a conducting fluid; this theory was founded by M. Kämtz, and among its adherents are MM. Schweigger, Colin, and Külle. (3) Those who consider it as a catalytic process, or as due to the action of porous bodies; this theory was founded by M. Berzelius. (4) Those who consider that fermentation is due to the action of certain nitrogenous matter, which is itself permanently in a state of decomposition, which is imparted to the sugar as soon as it (the sugar) comes into contact with the decomposing nitrogenous matter under favourable conditions—the consequence being the splitting up of the sugar into alcohol and carbonic acid; this view has been established by Dr. von Liebig, and is adhered to, among others, by MM. Frémy, Löwig, Gerhardt, &c. (5) Lastly, fermentation is viewed as being a kind of process of vegetation, the newly-formed yeast being considered as the newly-generated plant; this view is held by MM. Erxleben, Cagniard-Latour, Schwann, Dumas, Mulder, and others. The author relates the history of the views held on fermentation, as just alluded to, at some length, and winds up his lecture with a review on Dr. von Liebig's well-known essay recently published on this subject.

**Drying of Wood.**—R. Gottgetreu.—This paper is substantially the subject-matter of a lecture before the meeting of the Polytechnic Society of Munich in reply to the query, What means are applied at Munich for the proper drying of wood required for architectural, joiner's, and other purposes? The author enters, first, into a series of particulars relating to the very varying quantity of water (moisture and juices) contained in various kinds of wood at different periods of the year, from which it appears that, according to Dr. Hartig's experiments, woods (trees) generally contain, during the winter months, about an average of 50.7 per cent of moisture; in March and April, about 46.9 per cent; in May, June, and July, about 48 per cent; while up to the end of November the quantity of moisture increases but little. Air-dried wood (timber) contains from 20 to 25 per cent of water, and never less than 10 per cent. Wood which, by being artificially dried, has been deprived of all moisture, is thereby entirely altered as regards its cohesive strength—it becomes brittle, loses its elasticity and flexibility. In order to dry all kinds of timber by artificial means, so as to preserve the essential physical structure, and, thereby, the good properties of the wood, the drying should be effected slowly, and the temperature to which the timber is submitted should be moderate to begin with, and care should be taken not to eliminate all the water. The author enters into details, illustrated by engravings, on the best means of drying timber on the large scale, and states that small pieces of wood, such as are intended for joiners and furniture-makers, may be readily and efficiently dried by being placed in dry sand, and then heated to  $100^\circ$ . The sand acts in the manner of an absorber of the moisture, as well as a diffuser of the heat.

**Some of the Reactions of Water-Glass.**—Dr. F. A. Flückiger.—The author has instituted a series of experiments on the action of various salts soluble in water upon the so-called water-glass, solution of silicate of soda. As a general rule, the author found that the soluble salts of potassa, soda, lithia, and ammonia, more readily in water, possess the property of throwing down silica from a concentrated solution of silicate of soda. The experiments were made with a solution of silicate of soda of 1.392 sp. gr., which contained so slight an excess of soda that a single drop of alcohol, or a very weak acid, immediately precipitated silica from the solution. One part of this silicate solution diluted with 29 parts of water gives, with a solution of sal-ammoniac (1 of salt to 8 of water), upon being gently heated, a precipitate of silica. Caustic ammonia (sp. gr. 0.921) separates from the silicate solution, when cold, silica, but the precipitate is re-dissolved on heating. Propylamine also decomposes the silicate solution. The bromide and chloride of potassium in cold saturated solutions decompose the silicate solution on heat-being applied, but not so in the cold. A drop of bromine, a single bubble of chlorine gas, a drop of creosote (Reichenbach's), a drop of carbolic acid dissolved in glycerine, also dilute solutions of



albumen and gelatine, or glue, decompose the silicate solution, which is similarly affected by a solution of gum Arabic; while, on the other hand, other kinds of gum and mucilage, sugar, dextrine, glycerine, and urea do not decompose the silicate solution.

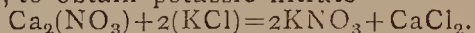
## NOTES AND QUERIES.

**Dextrine—Lactic Acid.**—Is there any quick and ready process for determining the presence and quantity of dextrine in a vegetable solution? Can it be distinguished from glucose when present in the same liquid? What is the best mode of determining the presence of lactic acid?—CARBON.

**Action of Light on Germination.**—I remember reading in your journal, some years ago, a statement, made by some foreign chemist, I think, that placing blue glass in the windows of a malt-house will materially hasten the process of malt-making. I have since looked through the first eight volumes repeatedly, but have failed to hit upon the paragraph.—ALFRED ASHBY.

[We have looked through the CHEMICAL NEWS, also the general index to the *Fahresberichte über die Fortschritte der Chemie*, and, lastly, the *Table Générale des Comptes Rendus des Séances de l'Académie des Sciences* from 1835 to 1865. The only paper which relates to the subject is "De l'Influence Qu'exercent sur la Végétation des Plantes, et la Germination des Graines, les Rayons Solaires Transmis à Travers des Verres Colorés. M. Zantedeschi (*Comptes Rendus des Séances de l'Académie des Sciences*, vol. xvi., p. 71).—Ed. C. N.]

**Condensation of Nitrous Vapours.**—I observe, in the CHEMICAL NEWS of Nov. 4, R. Heilmann and P. Hart have introduced the use of lime for condensing the nitrous vapours evolved in the manufacture of  $H_2SO_4$ . I beg to intimate that Mr. Barron, of Manchester, has used dry lime to condense nitrous vapours for the last ten years; and I believe I was the first to mix the solution of calcic nitrate with potassic chloride, to obtain potassic nitrate—



Practically, solution of  $Ca_2(NO_3)$  cannot be distilled with  $H_2SO_4$  in the ordinary nitric acid cylinders, owing to the acid acting upon the iron very rapidly. It must be in the solid state. Where magnesian sulphate forms part of the manufacture, I use lime made from dolomite limestone, which gives magnesian and calcic nitrates; and when distilled with  $H_2SO_4$ , we get soluble  $MgSO_4$  and insoluble  $CaSO_4$ . The mixture is digested with  $H_2O$ , a little  $CaH_2O_2$  added, to throw down ferric oxide, allowed to settle, syphoned off, and boiled to crystallising point, &c. By the use of lime on the large scale I have condensed the vapours from the manufacture of nitrate of iron, used by dyers, &c., which, in reality, is a ferric sulphate, the whole amount of hydric nitrate being decomposed into nitrous vapours. Also the nitrous vapours evolved in the conversion of arsenic trioxide into arsenic pentoxide. I was told by a large aniline colour maker that he sent up his chimney £100 worth, per month, of nitric acid; and his works are known by the name of "Red Smoke Works." Also the vapour evolved in making nitrobenzol from benzol. Iron turnings can be substituted for lime in the case of nitrate of iron.—H. H.

## MEETINGS FOR THE WEEK.

- MONDAY, 28th.—London Institution, 4. Dr. Odling, F.R.S., "On Chemical Action." (Educational Course.)  
 — Medical, 8.  
 — Royal Geographical, 8.30.  
 TUESDAY, 29th.—Institute of Civil Engineers, 8.  
 WEDNESDAY, 30th.—Society of Arts, 8.  
 — Royal, 4. Anniversary.  
 THURSDAY, Dec. 1st.—London Institution, 7.30. Prof. Morris, F.G.S., "On Gems and Precious Stones."  
 — Chemical, 8. W. H. Perkin, F.R.S., "On some Anthracen Derivatives."  
 FRIDAY, 2nd.—Geologists' Association, 8.

## TO CORRESPONDENTS.

\* \* Vol. XXI. of THE CHEMICAL NEWS, containing a copious index is now ready, price 11s. 4d., by post, 11s. 10d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our office, or, if accompanied by a cloth case, for 1s. Subscribers wishing to complete their sets of volumes are requested to apply to the publisher, who will give them information respecting scarce numbers and volumes. Vol. xxii. commenced on July 1st, and will be complete in twenty-six numbers. READING CASES, price 1s. 6d. each post free, may also be obtained at the Office.

ERRATA.—Page 242, column 2, line 20 from bottom, insert *nuclei*. Page 243, column 1, line 5 from top, instead of *analogous* read *anhydrous*.

Professor C. A. Seely (New York).—Thanks; our publisher will attend to your request.

Dr. C. M. Wetherill (Bethlehem, Pennsylvania).—Your communication just to hand; it shall receive early attention.

W. C. Roberts.—We are much obliged for the report.

R. R. Tatlock.—Received with thanks.

Rev. H. Highton.—Your letter shall be inserted in our next.

Clews, Habicht, and Co.—Received.

E. Ronalds.—Forwarded.

## A VICTIM OF THE WAR.

To the Editor of the Chemical News.

SIR,—I am quite sure I do not need to do more than ask the cosmopolitan Editor of the CHEMICAL NEWS to lay before the community of English manufacturing chemists the following extract from a letter received by a friend of mine in this city from Judge Neel, of Jersey, Channel Islands, and to whom, I may add, any communications on the subject of it might be addressed:—

"But the immediate object of my writing to you is to solicit your aid in finding a situation for a German gentleman whom this cruel Franco-Prussian war has thrown upon our shores. He was analytical chemist to the Western Railway of France, having Paris as his headquarters, with a salary of £400 a year. He was compelled to fly for his life, and was placed, by his employers, at Le Mons; after awhile, he was assailed there also, and has been obliged to leave France altogether. His former employers write him that the national feeling against the Germans is so great that it will not be prudent for him to return to France after the war, and that, therefore, he had better find a situation somewhere else. He wishes to remain in England. He has been placed, as it were, under my protection by a friend, and I feel great interest in him. He is a Lutheran protestant, single, but has a sister living with him, is twenty-nine years of age, and speaks English sufficiently well to make his way in England. He is a first-class theoretical and practical chemist and manipulator; an inventor; a translator of chemical works from German into French. He has given special attention to the utilisation of gas products; the manufacture of colours and dyes from coal-tar, of ammoniacal salts from the ammoniacal liquor, &c.; also to the manufacture of paraffin oils from petroleum and coal-shale, paraffin candles, &c. Would you kindly make enquiries, and let me know the result as soon as possible, as my friend's means are all but exhausted."

Should any one of your numberless chemical manufacturing readers have a vacancy which would enable him to obtain such an accession to his staff, he might, I think, serve both himself and his country in bringing a man of talent and technical skill to her shores.—I am, &c.,

FRANK SPENCE.

Manchester, Nov. 14th, 1870.

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The Session 1870—1871 will commence on the 3rd of October, when the Laboratories will be re-opened at 10 a.m. for instruction in Practical Chemistry as applied to Pharmacy, Medicine, Analysis, &c. Pupils can enter at any period. Terms moderate.

THE CHEMICAL and TOXICOLOGICAL CLASS will meet as usual every Monday and Thursday evening, at 8 p.m., commencing October 3rd.

The LATIN CLASS for the reading of Physicians' Prescriptions, Cæsar's Commentaries, &c., every Tuesday and Friday evening, at 8 p.m.

The BOTANICAL and MATERIA MEDICA CLASS, every Wednesday and Saturday evening, at 8 p.m. The usual EXCURSIONS for the STUDY of PRACTICAL BOTANY will be continued every Saturday, until further notice, at 10 a.m.

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# THE CHEMICAL NEWS.

VOL. XXII. No. 575.

## ON THE ACTION OF NUCLEI ON SUPERSATURATED SOLUTIONS OF SODIC SULPHATE.

By CHARLES TOMLINSON, F.R.S.

I HAVE read with very great interest the paper by Mr. A. Liversidge "On Supersaturated Solutions of Sodid Sulphate," contained in the last two numbers of the CHEMICAL NEWS.

Being very much occupied just now with literary work, I am unable to reply to that paper in a manner worthy of its author or the subject, which he handles with fairness and skill—but I hope to be able to do so shortly. At present, I propose to make a few remarks on the first half of Mr. Liversidge's paper; the second half will require more time on my part than I can at present afford.

Mr. Liversidge does not see the bearing of the camphor experiment on the matter in hand, namely, the crystallisation of a supersaturated solution of sodid sulphate. He imagines that the film arising from a secretion from the finger "may act by arresting the evaporation both from the surface of the water and from the camphor, for the latter in its movements would pick up a coating of oily matter, through which evaporation would not readily take place."

This, I imagine, is not the modern view of the phenomena of the camphor movements as taught by Van der Mensbrugghe and confirmed by Plateau and others. The motions of the camphor fragments depend on the surface tension of the water; and the effect of the secretion from the finger is to degrade this tension from that of pure and chemically clean water to that of camphor julep, when, of course, motion of the fragments is no longer possible.

When a quantity of a newly distilled essential oil, amounting to about 10 or 20 drops, is placed on the surface of chemically clean water in a clean shallow glass vessel about 3½ inches in diameter, it assumes a lenticular form, and is separated from the water by surface tension. If now some fragments of camphor be scraped upon the surface of the lens or of the water, or both, they at once become very active, skating through the lens and cutting it up in all directions. A solution of the camphor in the oil surrounds each fragment, and an iridescent film spreading from it as it sails about gives it an elegant appearance, often so symmetrical as to make it appear like a small brilliant butterfly. But what I want to insist on is the different conditions of the oil lens and the camphorated oil film; the one is separated from the water by surface tension, the other is closely adhering to it, overcoming or greatly lowering surface tension.

Now, when a drop of a liquid is placed on the surface of another liquid, there happens (apart from chemical action), one of three things:—(1). It diffuses through the liquid, and in general does not act as a nucleus to a supersaturated solution of sodid sulphate. (2). It spreads out into a film. (3). It assumes a lenticular shape. It becomes a film or a lens according to the general proposition, that if on the surface of the liquid A, whose surface tension is  $a$ , we deposit a drop of the liquid B, whose surface tension  $b$  is less than  $a$ , the drop spreads into a film; but if  $b$  be greater than  $a$ , or only a little less, the drop will be lenticular. Hence, if B spread on A, A will not spread on B.

In my experiments on the nuclear action of films it was quite easy to distinguish between the action of the film as such and that of a speck of dust from the air or contained

in the film. When the film spreads so as to overcome the surface tension of the water, or rather when the surface tension of the water is lowered at the contact surface common to the oil drop and the water, the surface of the latter not so acted on exerts a tensile strain upon the drop outwards in all directions, and so spreads the drop into a film, at the same time drawing it into close adhesion with the surface. It is this close adhesion which constitutes the first step in the nuclear action of films, the second being that differential kind of action by which I define a nucleus. Now, supposing the film to be thus produced, large flat crystals with dihedral summits of the 10-atom sodid sulphate are moulded, as it were, upon the lower surface of the film, parallel with it and limited by it, and as one set of crystals is formed and falls off, another set is produced, and yet another, until supersaturation ceases.

But when crystallisation sets in from a nuclear point or points, such as a speck or specks of dust, each point propagates its action downwards in minute crystalline lines at right angles to the surface or at angles of various magnitudes, and the crystals proceed to the bottom in close well packed lines, a phenomenon which is quite familiar; but I may be excused for the remark that the action of the film in forming large well-shaped crystals was, I believe, first described by me.

But now comes the question as to Mr. Liversidge's ingenious experiments, in which he succeeded about 120 times, or as many times as there were experiments, in placing thin films on his solutions without any separation of salt in any one case.

It will doubtless be granted that, in order for a film to act, it must be in contact with some part or other of the solution. If it be separated therefrom by surface tension it will not act. Mr. Liversidge, in order to get a film on the surface of his solution, makes an ethereal solution of the film-forming substance, and deposits a drop of that, trusting to the evaporation of the ether to spread out the film. Now any lowering of temperature increases surface tension, and my present impression is, that the evaporation of the ether so far increased the surface tension of the solution, that the film never once adhered to it, but was always separated from it by the superficial tension of the solution.

So, also, when Mr. Liversidge kept his clean finger in a solution lowered in temperature to 33° F., the surface tension of the solution was lowered thereby and the solution was separated from the finger by that tension. Had he been able to draw his finger strongly against the side of the flask, it is most likely crystallisation would have set in just as in my camphor experiment the fragments were brought to rest by a similar artifice. I have, on several occasions, kept my finger in highly supersaturated solutions of sodid acetate cooled down so as to be viscous, and protected from nuclei by a thin layer of oil, without any nuclear action, but on drawing the finger sharply against the side of the vessel so as to produce a *smear*, the whole became solid and very hot.

So, also, in the case of the glass rod and the greasy flask experiments—the solution rolled over them without wetting them. In other words, the solution or globules of the solution did not lose their surface tension to a sufficient extent to be brought into contact with the greasy surfaces.

Highgate, N.  
November 28th, 1870.

PS. Since writing the above I have found time to perform two experiments.

*Expt. 1.*—A very strong solution of sodid sulphate was boiled in a large flask and then filtered into six small flasks, each of which was again boiled and set aside to cool, covered with a watch-glass.

Some oil of citronella, diluted with two or three times its volume of ether, was taken up in a straight dropping-tube furnished with an india-rubber shield, as described in my



mode of testing M. Jeannel's experiment (see CHEMICAL NEWS, vol. xxi., p. 52).

The watch-glass was gently removed from the flask No. 1, and the dropping-tube inserted; after some minutes a drop fell from the tube, the ether in spreading over the surface described its cohesion figure, and the solution crystallised immediately. In Nos. 2 to 5 the dropping-tube was lowered so as to deliver the drop very gently, or it was allowed to trickle down the side of the flask. In two cases the ether evaporated and left the oil on the surface in minute lenses; there was no crystallisation even on gently shaking the solution. In No. 4 a film was formed on the side of the flask; on inclining it so as to bring the solution into contact with it, crystallisation set in. In No. 6 a film was formed on the surface; but on gently shaking the flask the solution became solid.

*Expt. 2*—A very strong solution of sodic sulphate was filtered into eight flasks, which were re-boiled and covered as before and left undisturbed until the next day. The ethereal solution was made more dilute in order to avoid, if possible, the formation of lenses. The solutions Nos. 1, 2, 3, and 4 crystallised the moment the ether solution spread over the surface.

The ethereal solution was now made less dilute; that is, about 10 drops of the oil were diluted with about 20 drops of the weak solution. A drop or two of this was allowed to run down the side of No. 5, when the oil became lenticular. In No. 6 the oil in running down the side formed a film. On inclining the solution so as to make it meet the film, crystallisation at once set in. In No. 7 the dropping-tube remained some minutes in the flask, and the ether, instead of falling in a drop, evaporated, and the vapour condensed on the surface of the solution in the form of a well-defined circular film, from the lower surface of which a beautiful set of large crystals was produced. In the flask No. 8, the tube remained some minutes, and then a drop fell and spread, and the solution became solid.

I cannot help thinking that Mr. Liversidge's solutions are only just supersaturated. I have already hinted at this with reference to his former sets of experiments (see CHEMICAL NEWS, vol. xxii., p. 110). As far as my experience goes, results are not to be depended on unless the solutions are highly supersaturated, *i.e.*, saturated, or nearly so, at the point of maximum solubility, so that a little anhydrous salt is thrown down at the boiling-point. I should also like to know the proportions of oil to ether used by Mr. Liversidge in making his films.

#### NOTE ON ITACOLUMITE (ARTICULITE).

By CHARLES M. WETHERILL, Ph.D., M.D.

I FEEL grateful to Professor A. M. Edwards, for having directed attention to itacolumite (CHEMICAL NEWS, vol. xxii., p. 111), although I cannot accept the correctness of his conclusions. I am not unfamiliar with the use of the microscope, which has held the place of honour in my laboratory for twenty years; nor were my inferences hasty, since I made careful examination of some forty specimens, being sections of different kinds of the mineral, cut in the plane of deposition, and at various angles thereto. I have been surprised that the wonderful structure of itacolumite, which seems to warrant the name I have proposed for it, has not attracted greater attention. This I can only account for by the natural incredulity which the announcement of such a structure would inspire, and in which I shared at first, believing that my eyes deceived me. It was only after long and patient examination that I became convinced of the nature of the joints, which are indeed very easily seen, and which I have shown to many visitors to our University. It would give me great pleasure to show them to Professor Edwards, whose difficulty appears to be in the interpretation of my words "ball-and-socket joints," in the idea that the motion "is much marked

in a direction at right angles at the lamination," and in the belief that the proof of the nature of the joints rests solely upon the microscope.

It may be said in respect to these—

(1). Each ball and socket does not admit of a great play, and is not smooth and perfect like that of the joint of a limb; it is, notwithstanding, perfect in principle of motion. The stone is built up of grains and congeries of grains loosely coherent, and forming irregular cavities in which are engaged projecting parts of other congeries or grains of sand, which are susceptible of a slight motion in the cavity—in some cases in one direction, and in others in several or in all directions. This freedom of motion is of the true quality of a ball-and-socket joint.

(2). The motion is *not* most "marked in a direction at right angles to the lamination." It is certainly so if a piece be taken of which the thickness is small in proportion to the other dimensions; but that is not the method by which the true motion is shown. A properly made section is susceptible of as much motion in the plane of lamination as at right angles to such a plane.

To prove this, I refer to the experiments (*American Journal of Science*, vol. xlv., July, 1867), upon a cylindrical rod of the mineral, 198 m.m. long and 13 m.m. in diameter, which was sawed from a thick block, and of which the axis was parallel to the planes of stratification. Supporting this rod upon two nails 185 m.m. apart, in order to determine the nature of the curve it assumed, the deflection was found to be essentially the same when the cylinder was rotated upon its axis on the supports. The difference was  $\frac{1}{2}$  m.m. of its greatest deflection of  $3\frac{1}{2}$  m.m., and had no relation to the stratification, being caused by a slight crack.

(3). The proof of the nature of the joints does not rest solely upon the microscope, although that alone is sufficient. The motions of the cylindrical rod afford an independent and equally convincing demonstration of the ball-and-socket character. There is no other kind of joint which could explain the motions which this rod is susceptible of, *viz.* :—"It can be *compressed* and *elongated* in the direction of its axis, the extent of motion being a little over  $\frac{1}{2}$  m.m. When one end is fixed, the other end may describe a circle of 34 m.m. diameter, and may be made to *touch every point in the area of the approximate spherical zone*. The rod can also be *twisted about its axis*, the torsion being  $10^{\circ}$ ." I may add that, by shaking the rod near the ear, one may hear the clicking of the joints as the motion is arrested at the limit of their greatest play.

The nature of the curve (nearly a catenary) when the rod is supported by its ends, agrees with the joints which I have described, and confirms also the revelations of the microscope.

I have never seen anything so wonderful as this rod of itacolumite. When held by one end upward, it totters in all directions, so that no one, seeing it at a short distance, believes that it is a stone. A gentleman from California, to whom it was shown, suggested jocularly that it would do well to build houses with in his earthquake shaken state. Indeed, I have no doubt that a sufficiently high and thin well-built wall would be susceptible of a decided motion before cracking. The height of wall, so much greater than its thickness, would permit the play of the innumerable small joints, existing from the bottom to the top, to be perceived.

In order to see the joints, a thin section, supported at one end or at both ends, may be moved while under the microscope with a needle point; by changing the position of the section, a part may be reached at which the play of the joints may be perceived. They can also be seen by *dissecting* a flexible piece of the mineral, using either a fragment or a surface rubbed flat. The surface to be examined is inverted, tapped, and, as far as practicable, brushed free from loose grains. It is then examined under the microscope with a power of 40 to 60 diameters.

The attention of the observer is first attracted by the irregular pits or depressions formed by grains of sand.



By very delicate touches with a fine curved needle point, the surface may be investigated; loose grains of sand are seen and removed. Touching other grains and congeries of them delicately with the needle, proves that some have motion in a cavity formed of grains of sand cemented together. These are dissected out, and other movable groups are found. Some have less motion than others, and some are immovable. By patient investigation of the mineral in this way, the observer will rise satisfied that it is made up of joints of the character which I have described.

This mineral is worthy of greater attention than has been bestowed upon it. Why are some of its constituent grains cemented together in such a curious fashion, and not all of them? I hazarded an explanation which was the best I had, but which was unsatisfactory to me; doubtless, some other observer will be more fortunate. It would not be surprising if the elucidation of this point would throw some light upon the origin of the diamond. Has itacolumite been found near the new diamond region of South Africa?

Bethlehem, Pennsylvania.

ON THE

COMPOSITION OF CRUDE SODA

(SO-CALLED SODA ASH OR BLACK ASH); AND ON THE LOSS OF SODIUM BY THE MANUFACTURE OF SODA ACCORDING TO LEBLANC'S PROCESS.

By M. A. SCHEURER-KESTNER.

As a result of investigations and researches made by me some few years ago on this subject, I found that crude soda contains, essentially, carbonate of sodium and sulphide and oxide of calcium in the proportion of from  $1\frac{1}{4}$  to  $1\frac{1}{2}$  molecules of calcium to 1 of sodium. The crude soda contains, moreover, all the foreign substances due to the impurities of the primary matters employed, as, for instance, silica, alumina, peroxide of iron, excess of carbonaceous matter, &c. Solutions of crude soda in water, treated with carbonic acid gas, after previous filtration to eliminate the matters insoluble in water, yields a white precipitate of silicate of alumina; this precipitate was found to be percentically composed of—Silica, 32.7; alumina, 44.0; water, 23.3;—formula,  $\text{Si}_3\text{Al}_2\text{O}_{12} + 6\text{H}_2\text{O}$ . By re-crystallising several times the soda contained in the solution just alluded to, the mother-liquors of these operations will contain the bulk of the impurities. Beside oxygenated sulphur compounds, I have found, in these liquors, seleniate and sulphocyanide of sodium. The selenium is derived from the sulphuric acid which has served for the preparation of the sulphate of soda, the acid alluded to having been made from the Chessy (France) pyrites, which contain a small proportion of selenium. The sulphocyanide of sodium is due either to the action of the air upon the soda while in pasty fused state, or is derived from the nitrogen of the coals which are used in the reduction process. The presence of this sulphocyanide is the cause of the ammoniacal smell given off by the ball soda while exposed to moist air for the purpose of cooling. In order to prove the presence of the compound just alluded to in ball soda, it is only necessary to exhaust it with alcohol; the ensuing solution is somewhat coloured, the colouration (either red or yellow) being due to traces of croconate and rhodizonate of sodium. I found, by treating 100 grms. of crude soda with alcohol, and evaporation of the liquid, 73 milligrms. of sulphocyanide of sodium. The seleniate of soda is found by precipitating the mother-liquors with a soluble salt of lead until the ensuing precipitate ceases to be coloured; by decomposing this precipitate by means of sulphuretted hydrogen, a mass is obtained which, when ignited, gives off the characteristic vapours of selenium. All the substances just alluded to occur in the normal crude soda; but, if

that substance has been over-heated (too strongly ignited), it also contains sulphide of sodium,  $\text{NaS}$ , derived from the reaction of the carbonate upon the sulphide of calcium.  $2\text{CaS} + \text{Na}_2\text{CO}_3 = 2\text{NaS} + \text{CaO} + \text{CO}$ .

*Loss of Sodium during the Preparation of the Soda.*—It is a well-known fact that, when working on the large scale, Leblanc's process does not yield, in practice, anything like what, according to calculation and theory, should be obtained. There is a loss of soda attributed by many chemists (including Dr. Unger, who found the loss from volatilisation of sodium alone to amount to one-fifth in one operation; while Dr. Stromeyer also ascertained the volatilisation of this metal, while experimenting on the large scale to carry out M. E. Kopp's process of soda making, by treating sulphate of soda with coal and oxide of iron) to volatilisation of metallic sodium occurring during the fusion of crude soda in the calcining furnace, because the soda retained as a soluble salt in the residue (waste) is not sufficient to account for the total loss.

The residues, or soda-wastes, are always found to retain a certain quantity of soda as soluble salts; but they contain a far greater quantity of soda in a state insoluble in water. The loss of soda incurred during the process of manufacture is therefore due to several causes, and among these—(1) to volatilisation of sodium in the calcining furnace; (2) soluble salts of soda retained in the waste in consequence of imperfect lixiviation; (3) soda retained as insoluble compounds in the waste; and (4) loss due to the manipulations of the liquors and salts during the process of manufacture. In order to determine the quantity of sodium volatilised during the calcination, it is required to operate upon materials of well-known composition, and estimate the sodium very correctly in all the products obtained. I am indebted to the kindness of M. Usiglio, who has made a series of such experiments, for his communications on this subject, especially the full account of his method of experimenting, which is so correct and good as not to leave anything to be desired.

Average samples of the sulphate of soda, chalk, and coal intended to be furnaced have been taken, and the quantities to be furnaced, as well as the ball soda, have been weighed as exactly as possible, and samples of all have been analysed with great accuracy, so that by these means, we could come to the knowledge of the quantity of sodium volatilised. My experiments, as well as those of M. Usiglio, have proved that, during the conversion of sulphate of sodium into crude soda (ball soda), no volatilisation takes place at all. The whole of the sodium originally present in the sulphate of soda is found in the crude product; but, if the furnace-temperature is too high, a small quantity of chloride of sodium is volatilised. Upon 1216 kilos. of sodium, as present in 3965 kilos. of sulphate of soda, I have found, in 6558 kilos. of crude soda, 1216 kilos. of sodium again. M. Usiglio has estimated quantitatively, in the raw materials, as well as in the crude product, the relations existing between the calcium, sulphur, and the sodium, and found—

	In the raw materials.	In the crude soda.
Sodium .. ..	31.68	31.49
Calcium .. ..	45.66	45.62
Sulphur .. ..	22.66	22.89
	100.00	100.00

If, therefore, any volatilisation takes place at all, it is clear that one should have to admit that the three elements sodium, calcium, and sulphur become volatilised exactly in the same proportion. Since it is thus proved that, under ordinary conditions, no reduction nor volatilisation of soda-salts and sodium takes place during the furnacing process, we have to look, therefore, in another direction for the causes of the loss of sodium daily experienced during its manufacture. The chief seat of this loss is proved to be the so-called soda-waste, which generally, it is true, retains, after lixiviation, only about 1-100th of soluble soda-salts; but the quantity of salts of



that base contained therein in the state of combination insoluble in water varies considerably. For instance, M. Unger found that the total quantity of soluble and insoluble sodium amounted, in the wastes of the Rinckuhl Alkali Works, to 1.06 per cent; M. Kopp\* found the waste of the works near Dieuze to contain 4.36 per cent; Mr. Brown† found the waste of the works at Cassel to contain 1.01 per cent; and Dr. Muspratt‡ states that the average at the Newcastle-on-Tyne alkali works amounts to from 1 to 2 per cent of sodium retained in the waste. I have had ground up 4000 kilos. (4 tons) of soda waste, and, after having thoroughly mixed this mass, have taken a fair average sample, which, after drying, has been analysed and found to contain—Insoluble sodium, 1.67; soluble, 0.17;—total, 1.84 per cent sodium. Another experiment, made with an average sample again taken from the quantity just alluded to, but not the same waste, has yielded—Insoluble sodium, 0.99; soluble, 0.43;—total, 1.42 per cent sodium. Since crude soda (black ash) leaves about 60 per cent of waste, and contains about 18.65 per cent of sodium, there results a loss of about 5 per cent of sodium in the state of insoluble compounds of that metal as retained in the waste.

The true nature and precise composition of this compound are unknown; the bluish hue of the waste favours the correctness of the opinion expressed by some makers that some ultramarine is formed. M. Kopp calculates this substance as sulphuret of sodium; and Mr. Brown notes it down in one of his analyses as sulphuret, and in another, again, as carbonate. The differences observed between the laboratory experiments made on crude soda and the results obtained by the lixiviation on the large scale, appear to indicate that a portion of the soda is rendered insoluble in water by its prolonged contact with water and the sulphides of the waste. However this may be, my researches prove—(1) that during the calcination process (furnacing) no soda-salts are reduced to metallic sodium; and (2) that the greater part of the loss of sodium is due to the formation of insoluble sodium compounds which are retained in the waste, a loss which certainly is never less than 5 per cent, and often very much larger.

## ON THE FUSIBILITY OF PLATINUM IN THE BLOWPIPE FLAME.

By W. SKEY,

Analyst to the Geological Survey of New Zealand.

THE metal platinum has hitherto been supposed to be infusible, except at a temperature that is so high, as to be incapable of being produced by the common blowpipe; at least I have carefully searched for any statements to the contrary without success.

When I was lately engaged in studying the effects of the hot-blast blowpipe flame, the results of which investigation have already been communicated to the Wellington Philosophical Society, I found it necessary to test, with accuracy, the degree of fusibility of platina; and discovered that if the loss of heat from the flame, by conduction, was guarded against, platinum can be fused with an ordinary blowpipe blast through a candle flame. The method adopted was to substitute, for the metallic nozzle generally employed, a tube of clay or glass, either of which is a feeble conductor of heat, as compared with metals.

By this means fine platinum points were fused in an unmistakable manner to beads. The blast was that ordinarily used in the laboratory by the use of the hydrostatic blowpipe, the flame being that of a stearine candle.

As it might be urged that, perhaps, the platina I treated might contain an admixture of more fusible metal, and that its melting-point might thus be reduced, I prepared

some of the platina for special trial, which was absolutely free from such fusible metals.

As the fusing-point of platinum has been ascertained to be 4593° F., we must, from the above experiment, conclude, that if proper precautions are taken to prevent loss of heat by conduction, this high temperature can be produced by the ordinary blowpipe operating upon flames of this description.

## ON FERMENTATION.\*

By Professor A. W. WILLIAMSON, F.R.S.

(Continued from p. 248).

Then there are some other processes of considerable importance, from their occurrence in the animal economy—processes which, I believe, must be classed between those experiments which I showed you a little while ago and the process of fermentation—I mean processes which occur in the operation of digestion. I have here a gelatinous solid, which contains a substance called pepsin, which was made by dissolving the inner lining of a pig's stomach in diluted hydrochloric acid at about blood heat. The inner lining of the stomach of that and similar animals is dissolved gradually, and that solution possesses the property of dissolving muscular fibre, white of egg, and other similar substances; it is, in fact, artificial gastric juice, and it would, for instance, dissolve that lump of gluten which I showed you just now—which looked something like india-rubber—and when this pepsin dissolves albumen by digestion, for the process is doubtless of the same kind as that which occurs in the animal economy, it does so by breaking it up into bodies which are, no doubt, simpler than itself, bodies which we do not know accurately and fully. They are called peptones, for it is common enough to give names to bodies, even before one knows them well. I do not know whether it is a good plan, but it is customary. These bodies are a good deal similar to those which are present in malt, and in such like mixtures which have undergone vital changes.

Then I will give you one or two other cases of similar processes. Here is a singularly beautiful acid, called hippuric acid, which decomposes with very great readiness if left in the liquids in which it is originally found. When that organic mixture is exposed to the air it undergoes a process of putrefaction. The general appearances which take place in the liquid while the substance is decomposing would certainly be described by anybody as a putrefactive process, and there is formed by its decomposition some of this other beautiful acid, called benzoic acid, because it was originally obtained from the fragrant gum benzoin. At the same time there are other products given off which decompose. Now, we can by mineral substances, effect the same decomposition of that hippuric acid. A German chemist, to whom we owe many researches in these matters, showed, some years ago that, if you boiled hippuric acid with dilute sulphuric acid, it takes up water, and breaks up into benzoic acid, and this crystalline substance, called glyocol, or sugar of glue. It got that name from the circumstance that it was obtained originally from glue by a decomposing action, and it has a sweet taste. It has no analogy to sugar, in its nature, but it has that superficial resemblance that it is rather sweet.

This hippuric acid affords another case of a body which is broken up either by putrefaction, or by the action of dilute sulphuric acid. It affords a strong argument, and other cases I have adduced afford, like it, an argument that the action of these organic substances resembles the action of dilute sulphuric acid. If we get the same change in several cases by the action of an organic body as by the action of a mineral body, the fact certainly goes some way towards showing that the two substances must be, in their mode of action, generally alike. There is another case, that of urea, which in contact with water

\* *Comptes Rendus*, vol. lxi., p. 797.

† *Philosophical Magazine*, vol. xxxiv., p. 15.

‡ *Chimie Appliquée à l'Industrie*.

\* The Cantor Lectures. Delivered before the Society of Arts.



forms a carbonate. That may be done by either class of reagent.

There are, however, some chemical processes even simpler than these, and for that reason they are better known to us, which really may be studied with advantage side by side with those I have mentioned, and they will, I think, afford us, on further consideration, a key to the explanation of these processes. I will only mention two. One is a process which is well-known in its general features, and it is a process of breaking up truly analogous to those I have mentioned, but a perfectly simple breaking up of alcohol into two substances, both of them well-known now, one being water, and the other ether. It is a process which consists in dividing the elements of alcohol in such a way as to get nothing formed but these two products, though side by side with this change there are some secondary changes which do not belong to the process. This change is effected solely by the action of oil of vitriol or sulphuric acid. It has been long known, and it was a subject of wonder for some time that, if sulphuric acid is mixed with alcohol and heated, you can distil off some alcohol from the mixture in the form of these two products; then you may add some more alcohol, and if you distil that off, it is also broken up into ether and water; then you may add some more again, and you may go on adding alcohol to that original quantity of sulphuric acid, and it will decompose each successive portion into these two products. There is no limit known to the extent to which sulphuric acid will effect that change. You perceive, therefore, that this, in its general features, is a process analogous to those which we were considering at first.

I may illustrate that by an experiment. First, I will show you how we discover the presence of sulphuric acid. The common test is to add some salt of baryta—this which I have here is a chloride—to the sulphate, when we get at once a precipitate sulphate of baryta. The sulphuric acid, in making the ether, passes over into a compound that does not possess this property. I have some of it here. It is a clear liquid, and on mixing it with the same reagent I used just now you see that it will not form the precipitate, I put some of the same baric chloride into it, but, as you see, the liquid remains clear. But I can bring back my sulphuric acid to its original state. Mr. Taylor, my assistant, was heating some of it just now, and it has been standing so long that it has returned to its original state already. It has returned from the state in which it does not precipitate baryta to the state in which it does. There is in the process a successive departure of the sulphuric acid from its ordinary state, and a return to that original state; it is a kind of circle or cycle. The substance passes over into a compound which does not precipitate baryta, and then it returns again to its original form, and that is the key to the anomaly. When the sulphuric acid has effected the decomposition of one portion of alcohol into ether and water, it comes back again to sulphuric acid, becomes exactly what it was in the beginning, and is able to recommence precisely the same combination. I will give you another example of it. I have here a substance used in one of the commonest manufactures, that of oil of vitriol, in which the same operation occurs. I have there a substance at work called nitric oxide. It is converting a quantity of sulphurous into sulphuric acid. In principle it would so convert an infinite quantity, but in practice it is limited by convenience. It acts by carrying oxygen from the air to one portion of sulphurous acid and then to another, and thus it goes on, and effects successive oxidations of a great number of particles of sulphurous acid, forming sulphuric acid from them, and it does that in virtue of a process perfectly analogous to that which I just now mentioned. The gas, after one operation, returns to the same state in which it was in the beginning of the first operation; it is a cyclical process. I have here some of the nitric oxide combined with oxygen, and when in that state it has the red colour which you see in the flask. If we blow a little sulphurous acid into it, the red colour will disappear as

the nitrous acid gives up the oxygen, the nitric oxide itself being a colourless compound, but in combination with oxygen it is red. As the sulphurous acid passes into it, the nitric oxide parts with the oxygen and becomes colourless, but on again blowing in a little oxygen it returns to its former red colour. This shows you that there are processes, of simple, normal, chemical action, somewhat analogous to those fermentive properties which I formerly described. Each one of these processes takes place in perfectly definite proportions, the peculiarity being that one material which takes part in them returns at the end of one operation to the same state in which it was at the beginning of the operation, so that the processes are cyclical, and this reagent is able, by acting successively on a large quantity of particles, to repeat its action very frequently upon them, and beyond what would appear to be its definite combining proportion. You see this red compound of nitric oxide and oxygen has lost a great deal of its red colour. I will not wait until it is completely bleached, but will blow in a little oxygen, when we shall get a return to the original deep red colour. This is the ordinary process by which sulphuric acid is made on a large scale in lead chambers. The sulphurous acid is allowed to remain a considerable time in the chamber, and is passed on from one to another, as it is acted on by the nitric oxide, which passes through the successive stages of its action by a process which I should be glad to name cyclical, as I shall have occasion again to revert to a similar process of the same name. At our next meeting I shall have to analyse some of the best known, and also some less familiar instances, of cyclical action, that we may arrive at a conception of their nature.

(To be continued).

#### ON THE INTRODUCTION OF THE PRINCIPLE OF REPETITION INTO CHEMICAL ANALYSIS.

By BRYANT GODWIN.

THE method of repetition, so frequently and so advantageously employed in physical investigations, has not, so far as I am aware, been applied to chemical analysis. It seems, at least, desirable that it should be so applied, and I will here give a particular instance in which it may be employed with advantage. In the determination of iron by means of potassic hypermanganate, all the iron is, at the end of the operation, in the form of sesquioxide, while there is also a very small excess of unreduced hypermanganate. When the solution is boiled for a short time with pure zinc-dust, and then filtered through a ribbed filter, which is quickly washed with water previously boiled to expel air, the iron is wholly in the form of ferrous oxide, and the process of titration may be repeated a second time. After a new reduction, the iron may again be determined, and this process may be repeated until the volume of liquid becomes too large to be easily handled. The following analyses were made to test this process:—

0.4725 gr. ammonio-ferrous sulphate required, in five successive titrations, 49.0, 47.2, 48.7, 48.0, and 48.5 c.c. of potassic hypermanganate, 1 c.c. corresponding to 0.0014 gr. iron. The mean of these five determinations gives 14.31 per cent iron in the salt.

0.4888 gr. required, in seven successive titrations, 49.5, 48.75, 50.5, 49.8, 49.7, 49.8, and 49.5 c.c. of hypermanganate, the mean of which gives 14.23 per cent iron.

The formula requires 14.27 per cent.

These analyses, which, with more practice and experience on my part, would doubtless have corresponded much more closely, will at least serve to show that the principle of repeated observations of the same quantity to be measured may sometimes be introduced into chemical analysis.—*American Journal of Science.*



## PROCEEDINGS OF SOCIETIES.

## MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

*Ordinary Meeting, November 15th, 1870.*

E. W. BINNEY, F.R.S., F.G.S., President, in the Chair.

JOHN DURHAM BIRD, M.D.; Mr. John A. Bennion; Henry Deacon, F.C.S.; Mr Joseph Carter Bell, and Thomas Steadman Aldis, M.A. were elected ordinary members of the Society.

MR. W. B. JOHNSON, C.E., brought before the notice of the meeting the extraordinary advance that had been made within the last twenty years in the capabilities of machines for cutting and paring heavy articles of machinery, and said this was particularly noticeable in the treatment of heavy forgings. At no very remote date it was the universal practice to pare down heavy forgings to something near the finished dimensions in the smithy by hand labour only; this mode of procedure was not only expensive, but rude and imperfect in its results. The introduction of tools to supersede the use of the hand chisel and file in the workshop has been developed to a remarkable degree. Machines are now made of such enormous strength, and the cutting tools so carefully devised, that the old system of paring down in the smithy has been set aside; this competition between the tools of the workshop, and the handwork of the smithy has resulted in establishing the system of tool paring in preference to smith-work to an almost universal extent. Twenty years ago there might be seen in engineering establishments a large smiths' fire, in which was placed a part of some heavy forging, and when the part under operation was heated to a blood-red heat, the superfluous parts were cut off by means of a set, upon which the successive blows of four and sometimes six strikers were delivered with surprising precision and regularity, and by these repeated heatings and dressings the forging would be eventually brought down to its finished dimensions, except by so much as was necessary for the final finishing or getting up. These operations in the smithy, as before observed, have now ceased; the forgings are taken at once and placed in a machine, which, by heavy and continuous cutting, soon pares down the forgings, and then finishes them without changing them to another machine or process. Tool paring is not only economical of labour, but the result as to accuracy is more satisfactory. Mr. Johnson then showed to the meeting some specimens of steel and iron parings sent to him by Messrs. Smith and Coventry, machinists, Salford, and further remarked that these parings demonstrated very clearly the capabilities of the machines and cutting tools of the present day. One specimen from a Bessemer steel shaft, the result of taking a cut  $\frac{1}{8}$ ths of an inch deep by  $\frac{1}{8}$ ths of an inch traverse, was particularly interesting on account of the form and size in which they, the parings, left the cutting tools. The cutting tools used in obtaining the specimens exhibited to the meeting were of a peculiar construction, and possessed some marked advantages over those in ordinary use.

*On the Temperature Equilibrium of an Enclosure containing a Body in Visible Motion*, by BALFOUR STEWART, LL.D., F.R.S.

It has been established that in an enclosure containing bodies which are all at the same temperature, and at rest, the same amount of heat enters any surface forming part of the walls of the enclosure as leaves it in the same time, so that the body, of which this is the surface, neither gains nor loses heat. It is also known that if we take not the outer surface of such a body, but any plane passing through its substance, say, for instance, one parallel to its outer surface, then as much heat passes across this plane going into the body as passes across it going out of

the body in the opposite direction; and further, this equilibrium of heat is known to hold separately for every one of the individual rays of which the whole heterogeneous radiation is composed.

The effect of the motion of the body in altering the wave-length of the radiated light is also well known. In consequence of this, if a cosmical mass, such as a star or nebula should be formed of incandescent hydrogen, and be at the same time rapidly approaching the earth, the light which strikes the earth will not be the double line D, but a line more refrangible than it, and therefore this light will be able to pass through a mass of ignited sodium vapour at the earth's surface without suffering absorption, while, however, the light emanating from the sodium vapour will still be the double line D.

In such a case, even if the star and the terrestrial sodium vapour should both be of the same temperature, yet the light radiated by the latter will not be the same in quality as that absorbed. This instance would appear to show that the equilibrium which holds in an enclosure of uniform temperature when all the substances are at rest does not hold when some of these are in visible motion, and that if in that enclosure there be a body moving towards or from the surface of the enclosure, the heat which enters the surface from the moving body will not be the same as that which the surface gives out.

Suppose, for instance, that the walls of the enclosure are made of glass, and the temperature of the whole enclosure, including that of the moving body, is  $0^{\circ}$  C., then, were the whole at rest, the heat which strikes the glass surface will all be absorbed at a very short distance below the surface, and in like manner the heat radiated by the glass will all emanate from a short distance below the surface. But let us now suppose, to take an extreme case, that the moving body is approaching one of the glass surfaces so rapidly that the heat which it emits has been so much increased in refrangibility as to enter the boundary of the visible spectrum.

Then while the heat radiated by the glass will still continue to proceed from a very short distance beneath the surface, the heat absorbed by the glass from the moving body will be able to penetrate to a very considerable depth beneath the surface of the glass.

The outer layer of glass will thus lose, while the inner layer will gain, heat.

Now, it is possible to conceive an enclosure with a fixed diaphragm, and containing a revolving body, so arranged that the heat which leaves it in the direction of a certain part of the enclosing surface, shall always be given out by that part of the revolving body which is moving towards the surface; while, on the other hand, the heat given out by the revolving body to another surface shall be given out when the revolving body is moving from that surface.

There will thus be a want of temperature equilibrium among the various layers, those near the surface being somewhat different in temperature from those beneath. But when we have a temperature difference of this kind, have we not acquired the power of converting heat into work? It would thus appear, at first sight, that the mere presence of a moving body has given us the power of obtaining work from an enclosure, all of whose particles were originally at the same temperature. This appears, however, to be opposed to the theory of the dissipation of energy, and in consequence we are induced to think there must be some error in the assumption.

Now, does not the unwarranted part of the hypothesis consist in our supposing that the revolving system can continue to revolve without losing part of its visible motion?

When two moving bodies approach or recede from each other, is it not possible that each loses a small part of its visible energy while at the same time there is a surface disturbance produced in both?

It might be said that believing in a medium pervading all space we were prepared for a stoppage of motion of this nature, and that there is, therefore, nothing gained



by the supposition which has been made; but it might be replied that, by looking at the problem in the above light, we appear to connect this stoppage of motion with other facts, besides being made aware of a source of surface disturbance when cosmical bodies approach or recede from each other.

*Postscript, added November 19th.*—If we imagine a stoppage of the motion of cosmical bodies of the nature above described, then if the two approaching bodies be exactly equal and similar, either extremity of the medium between them will be similarly affected by the motion derived from the approaching bodies; but if these bodies are unequal, the two extremities of the medium will be dissimilarly affected.

MICROSCOPICAL AND NATURAL HISTORY SECTION.

November 7th, 1870.

JOSEPH BAXENDELL, F.R.A.S., President of the Section, in the Chair.

MR. BAXENDELL reported that, in accordance with a wish expressed by the Council of this Section, the Parent Society had agreed to an alteration of the rules respecting the admission of Associates to the Section; in future the subscription for Associates, with the present privileges, will be 10s. per annum, and to those paying a subscription of 20s. per annum, the right of taking books out of the library will be accorded.

MR. SPENCER BICKHAM, jun., called attention to the very serious inconvenience that was experienced by all having occasion to distribute Natural History specimens, owing to the recent prohibition of the authorities to allow such parcels to be transmitted by "sample post," and it was agreed that a memorial be forwarded to the Postmaster General.

LONDON INSTITUTION.

ON Thursday evening, November 24th, Professor MORRIS, F.G.S., delivered a lecture "*On the Precious Metals and their Distribution.*" The chair was occupied by Mr. H. W. FIELD, F.C.S., Resident Assayer at the Royal Mint, and many other gentlemen interested in the working and manufacture of the precious metals were among the audience. In the first part of his lecture, Professor Morris brought forward a vast array of facts relating to the use of gold and silver by the ancients, particularly the Egyptians, who seemed to have obtained their supplies of the former metal from Nubia. The lecturer dwelt at length on mode of occurrence of the precious metals, their geographical range, geological position, and economic uses, illustrating his remarks with maps, models of nuggets, and numerous beautiful specimens of native gold. In discussing the geology of gold, he said that this metal was found distributed through rocks, quartz veins, or alluvial deposits. The Silurian rocks, and the granites associated with them, furnished the greater quantity, but the cretaceous-oolitic rocks of Peru, Bolivia, and California when, traversed by dioritic igneous rocks, were also auriferous, showing, according to Mr. David Forbes, that there were too well-marked epochs of gold intrusion. From both formations, but specially from the Silurian, the gold found in alluvial deposits is derived, the auriferous rocks having undergone erosion to an enormous extent at a comparatively late geological period, namely, the Newer Pliocene. The remains of extinct mammalia, discovered in the deposits of the Urals, and also in those of Australia, had satisfactorily fixed their geological age. In noticing the more important points connected with the gold coinage, Professor Morris referred to the remarkable brittleness of gold alloys containing minute quantities of palladium.

On Monday afternoon, November 28th, Dr. ODLING delivered the fifth lecture of his educational course, "*On*

*Chemical Action,*" to a crowded audience, comprising a large number of boys and girls from the schools of London and its environs. In this lecture the chemistry of burning or destruction was entered on, and almost every fact brought forward was the subject of a striking experiment.

CORRESPONDENCE.

ON THE MAGNETIC POWER EVOLVED BY A GALVANIC BATTERY.

*To the Editor of the Chemical News.*

SIR,—In your journal of the 28th ult. (CHEMICAL NEWS, vol. xxii., p. 205), there was an abstract of a paper by the Rev. H. Highton, "*On the Maximum of Magnetic Power Evolved by a Galvanic Battery.*" In that paper Mr. Highton says—"Can we, then, get infinite power out of a finite source of force? Yes. But on this condition, that what we gain in power we lose in time; for the current would take twice as long to traverse the second circuit, and therefore it takes double the time to produce double the magnetic power. But the electric current is so rapid that this difference of time is inappreciable within any practical limits." It appears to me that this last sentence entirely nullifies the previous remark, that "what we gain in power we lose in time"; in other words, I understand Mr. Highton to assert that we can obtain infinite power out of a finite source of force. Does Mr. Highton attach different meanings to the terms "power" and "force"? These terms are usually considered to be synonymous. If they are, the above statement is a logical contradiction in itself; if, in Mr. Highton's opinion, they are not synonymous terms, might it not be advisable for him to define what are his conceptions of the meanings of the terms "power" and "force"?

In another place, speaking of doing work, Mr. Highton says—"But this work is being done every time that the circuit, after being broken, is closed; and the circuit may be broken and closed so many times a second, that the number is practically illimitable, and hence the amount of work that can be done by a given battery is illimitable. The only question is a question of first cost of machinery."

Now I presume that Mr. Highton means, by a "given battery," one capable of distributing a definite quantity of force. Referring to the above paragraph, it would appear that the source of force (the battery) was governed solely by the operation of breaking and closing the circuit. Is the magnet itself a progenitor of force? Mr. Highton does not say.

Furthermore, is Mr. Highton aware of the fact that, in practice, it is found that a "given battery" will not supply the requisite amount of force for an unlimited quantity of magnetic machinery? Possibly I have misunderstood Mr. Highton's statements; but, as the subject is of great interest, I should feel obliged if you would insert this letter in your valuable journal.—I am, &c.,

ROBERT SPICE.

40, Cirencester Place, W.,  
Nov. 17th, 1870.

ON THE MAXIMUM OF MAGNETIC POWER EVOLVED BY A GALVANIC BATTERY.\*

*To the Editor of the Chemical News.*

SIR,—I gladly avail myself of the opportunity afforded me by Mr. Spice's letter, which you have kindly communicated to me, to enter more fully and deeply into the question raised by me in my paper read before the British Association.

Let me first, then, define what I mean by "force" or "power," which, as Mr. Spice justly observes, are synonymous. I will define, then, in this connection, the

\* To save time, Mr. Spice's letter was forwarded in proof to Mr. Highton, and we are thus enabled to lay before our readers this reply.



amount of magnetic force or power to be "the number of units of weight which the magnet will raise through a unit of height." In the case of a magnet, the unit of height taken should be small, because the power varies considerably (generally inversely as the square) at different distances. I might define magnetic force to be the amount of weight which a magnet will sustain, which is in proportion to the weight raised through a unit of height, but it might be objected that this is only a static, not a dynamic, force. It might be defined in many other ways, but I think this will answer the purpose and be as simple as any. It might be measured by the method of torsion, or the number of oscillations caused in a second in a magnetic needle. While I am giving definitions, let me say that by "a given battery" I do not mean "one capable of distributing a definite quantity of force," for that involves the very question at issue; but I mean a battery of a given number of cells, with elements of a given size and of a given material, at a given distance from each other in a given electrolyte; and by the maximum of magnetic power evolved by it, I mean the maximum power evolved by a given consumption of zinc or other positive element. It has always been assumed, as a kind of axiom, that a given battery, by a given consumption of zinc (or a given amount of chemical change), can only produce a certain maximum of force. Now the question I wished to raise was whether this was true; whether facts, and the ordinary accepted laws based on facts, did not show that a given amount of chemical change could, by skill, be made to produce any amount of force whatever. I do not care to defend the suitability of the terms or manner in which I expressed myself in the abstract of my paper read at the last meeting of the British Association; but what I do wish is to raise this grand question.

I am quite aware that, at present, the majority of the scientific world would at once decide in the negative *a priori*—and perhaps refuse even to discuss it. But it is a question, not of preconceived theory, but of fact. When Galileo dropped weights of one pound and ten pounds from the tower of Pisa, and the sound of their collision with the ground rung on the ear simultaneously, the scientific men of the day refused to believe their senses, because Aristotle had shown that a ten-pound weight must fall ten times as fast as a one-pound weight. But facts have since proved too strong for theory. I freely confess that I was indistinct and obscure in my mode of expressing myself in the paper above mentioned, and therefore let me now state distinctly that what I wish to assert, as at present advised, is that a given amount of chemical change can be made (I do not say economically or conveniently, but *can* be made) to produce an unlimited amount of force. I wished in the reasoning and experiment given in that paper to show that whatever amount of force a battery was producing, that amount might be doubled or, in fact, increased indefinitely.

To simplify the matter, let me take the simplest possible case. Take a battery with an exterior circuit consisting of one electro-magnet, which shall be capable of sustaining  $n$  pounds when the circuit is closed. Then I assert that if for the one electro-magnet  $n$  electro-magnets be substituted, and the current passed in succession through them, each electro-magnet will sustain one pound, and also that if in the first case the battery were consuming  $n$  grains (or other units) of zinc per second, it will now only consume one grain, so that the consumption of one grain of zinc will now produce as much force as  $n$  grains did before. I may say, indeed, that, as a matter of fact, each magnet in the second case will sustain rather more than one pound, for, on account of reasons which it is not worth while here to enter into, the magnetic force will decrease rather less than in proportion to the intensity.\*

But, to probe the matter to the bottom, we must divide the time during which the battery acts into three periods, and describe what takes place during each. (1) The time which it takes the electric force to traverse the circuit after it is closed. This in ordinary cases is infinitesimal; but where the circuit is very long, and where there is much inductive as well as conductive resistance, as in the Atlantic Telegraph, the time becomes very appreciable. But I would remark that the expenditure of zinc during this first period is occupied in producing a state of tension in the conductor which, theoretically speaking, forms a store of available force that may afterwards be recovered. (2) There is the period during which the magnet is pulling its keeper to itself, and is positively doing actual work. Now, paradoxical as it may seem, it is a fact that during this period (No. 2), while the magnet is doing actual work, the intensity and the consumption of zinc is actually diminished, so that, in one sense, the more work done the less the fuel (so to speak) which is consumed in doing it. It is in this point that a galvanic battery differs from other machines which do work. It is as if a horse, when he did work, ate actually less food than when he was idle, and wasted less muscle, or as if a locomotive consumed less fuel when in motion than when at rest. (3) Then comes the third period, when the keeper has been pulled home, and the weight is merely sustained. During this period no actual work is being done, and the weight sustained only shows what work the magnet is capable of doing, and so serves as a measure of its potentiality, and during this period (No. 3), strange to say, more zinc is consumed per unit of time than while the work is being done. In practice, therefore, in an electro-dynamic engine, period 3 should be reduced to *nil*.

Now break the circuit. If there be a secondary wire (as in a Ruhmkorff coil) the tension produced during the first period may be utilised in some way by the counter current produced in thus breaking the circuit, and the same series of phenomena may then begin over again.

What I contend, then, is briefly this (and I will put the matter as distinctly as I can)—that though by lengthening the circuit we prolong the time (period No. 1) which elapses before the magnetic force begins to act, we nevertheless, out of the same consumption of zinc, get an indefinite increase of the force produced. And here let me add that if an electro-dynamic engine were made to act by producing continuous rotation without alternately breaking and closing the circuit, period No. 1 would only come once during the time the engine was at work.

This conclusion of mine may appear paradoxical, but I believe it to be true, both because well-known laws lead logically to it, and because I have found the fact confirmed by experiment. There is one analogous case perhaps still simpler. Take a battery, insert in the circuit a voltmeter with silver electrodes, and containing solution of nitrate of silver. Now separate the electrodes to a distance from each other  $n$  times as great as before. This will simultaneously diminish the intensity and the consumption of zinc, but the result will be that the consumption of one equivalent of zinc will convey an equivalent of silver over  $n$  times the distance it did before; or if the size of the plates of the battery and of the electrodes be increased severally  $n$  times, so as to make the intensity the same as at first, one equivalent of zinc will convey one equivalent of silver  $n$  times the distance it did before and in the same time.

One word more, though this letter is already too long. But the subject is important, and it is impossible to be at once full and concise. If the magnetic power of a battery is not illimitable, what is its limit? Let some one give me a reply. The only reply I can find is a statement that the greatest amount of energy is produced in the exterior part of a battery circuit when the exterior and interior resistances

\* I have since found this to be strictly true only when the experiment was tried under certain conditions. What is strictly true is, that the power of the wire to act on a magnet follows this rule. The actual weight sustained by a magnet depends on numerous subsidiary conditions.



are equal.\* Now, in the first place, this can only be true in any case when we do not take into account the amount of zinc consumed, and in the second place it is only true of the *heat* produced, and it is assumed that all other kinds of energy are in proportion to the heat, than which I venture to say no greater error has ever obtained so wide a credence in an age of critical science. If it were true, all our galvanometers should be formed with short lengths of as thin wire as possible, and our electro-magnets and helices should also be made with very thin and very short wires, which every one knows in practice would be absurd.—I am, &c.,

H. HIGHTON.

Putney, Nov. 22nd, 1870.

PS.—In my letter written to you last week, and in a paper read to the British Association, I maintained that the negative force to be derived from a grain of zinc was without limit.

I gave experiments which proved this, for I showed how a definite force could be got from an indefinitely diminishing consumption of zinc, or an indefinite increase of power from the same consumption.

In fact, my experiments, when I tried them, proved more than this, for, having first found that a battery working a magnet sustained 8 lbs., I made it support 9 lbs. with half the consumption of zinc. I also found an equal consumption of zinc supported 18 lbs. by mere alteration of arrangements. As other people may repeat the experiments and find them fail, I may say that I have since found that the particular alterations of arrangements here described, though answering in that particular case, will by no means answer in all cases. The laws of magnetic power vary so very much in different condition of sizes of wire, dimensions of iron core, and battery strength—conditions which can only be learnt by an immense variety of experiments, that it requires a very special and particular knowledge and experience to apply the particular expedients required under varying conditions.

Nevertheless, in all cases the difficulties may be got over by skill, and the truth, theoretical and practical, remains the same, that the magnetic power of a battery may be increased without limit.

The magnetic power of a circuit is always measured (according to varying conditions) by some power or other of  $l \times i$ ,  $l$  being the length of wire outside the battery, and  $i$  the intensity of the circuit, and as  $l \times i$  may be increased without limit, the magnetic power may be increased without limit. How to vary  $l$  and  $i$  to the greatest advantage under varying circumstances is the problem which exercises the skill of the engineer. This I may safely say, that never yet has any electro-motor been constructed with a real knowledge of the scientific problem to be solved. I propose shortly to discuss Jacobi's paper on the subject written in 1850 which still remains the great authority, but which is full of errors.—H. H.

## PURIFICATION OF SYRUPS.

*To the Editor of the Chemical News.*

SIR,—Although I am in no way called upon to act as champion for Dr. Seyferth and his process, yet I think it is only right to state that Dr. Calvert, in his letter in your last impression, seems to have misunderstood the claim Dr. Seyferth is putting forth. He cannot, and does not, claim to be the first inventor of a sulphurous acid process for the purification of syrups, for already, as far back as 1849, M. Melsens published such a process, which at once

\* I have tried to trace this strange error, which is committed, I find, by Jacobi, De la Rive, Du Moncel, by Professor Foster in the "Chemical Dictionary," and I have no doubt is copied in all our text-books. In some cases I find it deduced from the law of the maximum of heat; in the case of Du Moncel it is due to a most remarkable mistake in an algebraical formula.

raised a great deal of attention on the Continent. I 1858, Dr. Calvert and M. Sievier came out with their plans, and in 1863, the processes of Reynoso, and especially of Possoz and Perier, produced the greatest sensation among German sugar manufacturers. I may safely say that there is not one of the latter class who is not acquainted with this subject, and a gentleman of Dr. Seyferth's attainments would have all these processes at his fingers' ends—among them also Dr. Calvert's, which is quite well known in Germany, as far as published. The feature Dr. Seyferth is claiming as a new one is evidently only the way of employing the sulphurous acid solution, viz., by sucking it up into the vacuum pan along with the syrup; he distinctly states that only by using it in the vacuum pan it can be completely removed again. This seems to be new, and a *prima facie* argument for the real novelty of the process is this, that it has been so warmly recommended by the German Association of Beet-root Sugar Makers, which commands *savans* of the most extensive knowledge of everything published in the matter of sugar making and refining. Without, therefore, taking away from Dr. Calvert's merits, I think Dr. Seyferth has other merits of his own.—I am, &c.,

GEORGE LUNGE.

## PRESERVATION OF STONE.

*To the Editor of the Chemical News.*

SIR,—In his letter which appeared on the 18th of November, Mr. Spiller seems to have completely disposed of his own claim to the superphosphate process, by allowing Coignet's prior use of this method to render a calcareous cement non-absorbent. In both cases the same solution is employed for the same purpose, and with the same result, namely, the conversion of calcium carbonate into tricalcic phosphate by means of a solution of monocalcic phosphate. I take for granted, from Mr. Spiller's silence on the point, that he has abandoned his solution of superphosphate mixed with a little baryta, the really original part of his method.

The legal questions as to patents which Mr. Spiller raises I do not feel to be within my province to discuss.—I am, &c.,

A. H. CHURCH.

Royal Agricultural College, Cirencester,  
November 28th, 1870.

## MISCELLANEOUS.

The Royal Society.—The annual meeting of the Fellows of this Society was held on the 30th ult., at Burlington House. The President, Lieut.-General Sir Edward Sabine, K.C.B., &c., delivered the inaugural address, in which he reviewed the progress which had been made in science during the year. In closing his address Sir E. Sabine announced his intention not to offer himself for re-election at the next anniversary, when, to quote his words, he "will deliver over the chair, doubtless to a younger, it may well be to a worthier, occupant; it can hardly be to one having the welfare of the Royal Society more warmly at heart,"—a sentiment which was cordially echoed by all present. The presentation of the medals followed:—The Copley Medal was awarded to Mr. James Prescott Joule, F.R.S., for his experimental researches on the dynamical theory of heat; a Royal Medal to Professor William Hallowes Miller, Foreign Secretary R.S., for his researches and writings on mineralogy and crystallography, and his scientific labours in the restoration of the national standard of weight; a Royal Medal was also awarded to Mr. Thomas Davidson, F.R.S., for his works on the recent and fossil Brachiopoda, more especially his series of monographs in the publications of the Palæontographical Society; the Rumford Medal to M. Alfred Olivier Des Cloizeaux, for his researches in mineralogical



optics. The following gentlemen were then elected officers and council for the ensuing year:—President, General Sir Edward Sabine, R.A., K.C.B., D.C.L., LL.D.; Treasurer, Mr. William Spottiswoode, M.A.; Secretaries—William Sharpey, M.D., LL.D.; Mr. George Gabriel Stokes, M.A., D.C.L., LL.D.; Foreign Secretary, Professor William Hallowes Miller, M.A., LL.D. Other member of the Council:—George Burrows, M.D.; Mr. Heinrich Debus, Ph.D.; Peter Martin Duncan, M.B.; Sir Phillip de M. Grey-Egerton; Professor George Carey Foster, B.A.; Mr. Francis Galton; Mr. John Peter Gassiot, D.C.L.; Joseph Dalton Hooker, C.B., M.D.; Mr. William Huggins, D.C.L., LL.D.; Professor George M. Humphry, M.D.; Mr. John Gwyn Jeffreys; Sir John Lubbock; Mr. Charles William Siemens, D.C.L.; Professor Henry J. Stephen Smith, M.A.; Professor John Tyndall, LL.D.; Professor Alexander W. Williamson, Ph.D. After the meeting the Fellows and their friends, including Mr. Gladstone and the Lord Chancellor, dined at Willis's Rooms, the President occupying the chair.

**The Purification of Paraffin.**—The Mineral Oil Company (Mineralöl Verein), of Halle, in Prussia, offer two prizes of 5000 thalers for the solution of the two following technical questions. The one is, to find a chemical means of purifying crude pressed cake paraffin with the least possible loss, which must not exceed 5 per cent. The other is, to devise a method for cooling masses of paraffin to a temperature of at least 5° C. at any season of the year. Among the materials for the purification of the press cake, colourless oil of tar, benzol, and all like substances which exercise a solvent action on paraffin, are forbidden to be used. The loss of paraffin, when press cake free from dirt is operated on, must not exceed 5 per cent; the process of purification must be rapid and easy of application, and must not be attended with any considerable cost. The refined paraffin is to have a bluish-white colour, and must be colourless. The process for cooling masses of paraffin must admit of 500 cwt. of material being cooled each day, in vessels containing 5 cwts. each, to a temperature of at least 5° C., the cooling to take place either in one place or several. It would be preferable for this to be brought about by cooling the room in which the paraffin candles are left to crystallise. The cooling of the material must be brought about gradually, and in such a manner that the formation of crystals, in respect to their constitution and magnitude, be in nowise interfered with. The answers must be sent in by the 1st January, 1871, and they will be considered by a commission appointed by the Mineral Oil Company of Halle, and composed of Mr. Riebeck, of Halle; Bergrath Bischoff, of Weissenfels; Dr. Rolle, of Gerstewitz; and Dr. Hübner, of Zeitz. In the event of competition, the prize will be awarded to the proposer of the most advantageous solution to the question.—*Journal of the Society of Arts.*

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

*Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

*Polytechnisches Journal von Dingler*, second number for October, 1870.

This number contains the following original papers and essays relating to chemistry and collateral sciences:—

**New Aneroid Barometer for the Barometrical Determination of Heights.**—J. Goldschmid.—This paper contains the description, illustrated by a series of engravings, of an improved and accurate

aneroid barometer, which is better fitted for the measurement of mountain heights and elevations above sea level generally.

**Convenient Alteration in the Arrangement of Bunsen's Galvanic Battery.**—Dr. D. Laschinoff.—This paper, treating on an improved arrangement of Bunsen's galvanic battery, cannot be usefully abstracted without the reproduction of a series of engravings.

**Description of an Apparatus Contrived for Exhausting Substances.**—F. R. von Schwind.—This paper, illustrated by a series of woodcuts, contains the detailed description of an improved apparatus contrived for the purpose of extracting salts soluble in water from insoluble or more difficultly soluble materials.

**Enamelling of Iron.**—Dr. E. M. Dingler.—The author first points out that the main difficulty in the process of enamelling iron consists in the fact that the expansion of the metal by any increase of temperature is far greater than the expansion of glassy bodies, and that, as a consequence, the enamel is very liable to come off by a sudden increase of the temperature of the enamelled metal. This defect, says the author, is best mended by the use and application of a ground, or first layer, which does not become quite fluid by heat, but retains a pasty consistency and porosity, which enable it to give way to some extent by the expansion. On this first layer, the second, or covering layer, is applied. The author recommends the following mixture as ground or first layer:—Pulverised quartz, 30 parts; borax, 16½; white-lead, 3 parts. These ingredients are fused together, and the molten mass is pulverised and intimately mixed with 9 parts of very finely ground-up quartz, 8½ parts of washed pipe-clay, and ½ part of magnesia alba. The second, or covering layer, is prepared by melting together a mixture of 37½ parts of pulverised quartz, 27½ of borax, 30 of oxide of tin, 15 of carbonate of soda, 10 of nitrate of potassa, and 5 parts of magnesia alba. The molten mass is poured into water, and afterwards mixed with 6½ parts of powdered quartz, 3½ of oxide of tin, ¾ of carbonate of soda, and ¾ parts of magnesia alba, and the whole of the ingredients very finely ground along with water, so as to constitute an impalpable powder. The metal to be enamelled is first cleaned with dilute sulphuric acid (1 part of strong acid to 24 of water), then rubbed with sharp sand, rinsed in hot water, and immediately afterwards dried; the enamel masses are next burnt on. Well made enamel exhibits the following characteristics:—A perfectly smooth and level surface, so that the surface nowhere feels uneven or rough to the touch; a pure white colour; absence of small cracks.

**Contribution to our Knowledge on Chlorimetry.**—Dr. C. Winkler.—This very lengthy essay records a series of experiments instituted by the author to test the accuracy of Dr. R. Wagner's method of the estimation of chlorine contained in bleaching-powder (hypochlorite of lime); also as compared with the methods of MM. Penot and Mohr. The method of Dr. R. Wagner is based upon the decomposition of a certain volume of a solution of hypochlorite of lime, by means of the addition thereto, first, of iodide of potassium, and next of dilute hydrochloric acid, and estimation of the quantity of iodine set free by means of a titrated solution of hyposulphite of soda. Dr. Wagner recommends to take 1 grm. of hypochlorite of lime to 100 c.c. of water, 2.5 grms. of iodide of potassium dissolved in 25 c.c. of water, and to add dilute hydrochloric acid until an acid reaction is apparent (this method is described at length in Dr. Dingler's *Polytechnisches Journal*, vol. cliv., p. 146, 1859). The exhaustive researches of the author of this paper prove that this method is, when executed with care, very correct in its results and thoroughly reliable in practice.

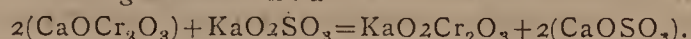
**Abnormal Behaviour of Mahrenberg Magnesite.**—Dr. H. Schwarz.—While engaged in making some experiments on the manufacture of the Sorel magnesia cement (viz., calcined magnesite mixed with a solution of chloride of magnesium), the author applied for that purpose the magnesite of Mahrenburg (Styria); but, finding that it did not become a hard mass, he analysed this mineral, and found it to contain, in 100 parts—Carbonate of magnesia, 92.52; carbonate of lime, 3.55; carbonate of protoxide of iron, 3.79; insoluble sand, 0.14. At first, the author ascribed the non-hardening of this magnesite, after having been calcined, to the presence therein of carbonate of lime and oxide of iron; but, on making an experiment with amorphous magnesite from Friedau, which contains, after calcination, 2.38 per cent of lime and 0.43 per cent of oxide of iron, it became evident that these impurities did not interfere with the hardening. The author explains the difference by the fact that the Mahrenberg magnesite is a crystalline substance, and stands to the Friedau and Frankenstein magnesites (both amorphous, and the latter especially a very pure material) in the same relation as calc spar (Iceland spar) to arragonite, a view which was proved to be correct by taking the specific gravities of the various magnesites alluded to.

**On Wocheinite.**—Dr. H. Schwarz.—Under the above name, derived from a locality in Austria, the author gives an account of some experiments made with a hydrate of alumina found in the Wochein, and akin to the Bauxite. This wocheinite consists, in 100 parts, of—Alumina, 56.82; silica, 11.28; peroxide of iron, 1.60; water, 24.20; traces of carbonate of lime and of manganese. The mineral is suitable for being mixed with other fire-clays (it is not sufficiently plastic by itself even when pulverised), and for the manufacture of aluminate of soda and other salts of alumina.

**Manufacture of Chromate of Potassa.**—Dr. H. Schwarz.—After referring, at some length, to the well-known method of the preparation of chromate of potassa on the large scale, the author relates a few laboratory experiments made with the view to test whether there is any necessity for using, as is usual on the large scale, sulphate of potassa along with the chromate of iron and lime. The result of the author's experiments is, that, when a mixture is made of 1 equiv. of oxide of chromium and 2 equivs. of lime, and these substances very intimately mixed and heated in a muffle, there is obtained a bright yellow-coloured powder, which contains as much as 85 per cent of the oxide of chromium used in the state of chromic acid. The author comes to



the conclusion that the sulphate of potassa is not necessary in the mixture during ignition, and that the chromate of lime formed during the ignition may be advantageously decomposed by bisulphate of potassa, according to the formula—



**Decomposition of Chloride of Potassium by Sulphate of Magnesia.**—Dr. H. Schwarz.—This paper contains the record of a series of experiments made with the view to elucidate the various reactions and formation of double salts which are observed to take place when equivalent proportions of chloride of potassium and sulphate of magnesia are mixed together, having been previously dissolved separately in water. In the first place, there is formed, under these conditions, the well-known potasso-magnesia double salt. This salt having been re-crystallised from a quantity of water, insufficient for its solution, the author obtained—(1) a residue of pure sulphate of potassa, containing 46.07 per cent of sulphuric acid, instead of 45.42, as required by theory; (2) the solution yielded on first crystallisation,  $\text{K}_2\text{SO}_4 \cdot \text{MgSO}_4 \cdot 6\text{aq}$ , containing, in 100 parts, 39 per cent of sulphuric acid; (3) the second crystallisation yielded a salt wherein the sulphate of magnesia predominates, and consisting, in 100 parts, of 25.12 of sulphate of potassa, 36.21 of sulphate of magnesia, and 38.65 of water, of which 32.49 per cent is eliminated at 100°, and 5.66 by ignition.

**Acid Nature of the Organic Matters present in River and Spring Water.**—F. Stolba.—The author states that, according to his experience, obtained by making (in Bohemia) a large number of water analyses, all waters which contain a large proportion of organic matter contain it in combination with bases, chiefly lime, and that, therefore, the organic matter is (as already suggested, and partly experimentally proved by Berzelius) of an acid nature.

**Simple Method of Detaching Paint and Lacquer-Work from Tinned Iron.**—Dr. H. Emsmann.—This method comes virtually to the use of mercury, or of a piece of wash-leather impregnated with that metal, after a slight portion of the paint or lacquer has been first removed from the tinned iron by mechanical means.

**Preparation of Condensed Milk.**—Dr. Trommer.—A lengthy essay on this subject, but not suited for useful abstraction.

**Artificial Formation of Graphite.**—Dr. R. Wagner.—After briefly alluding to some reactions by which the origin of native graphite might be referred to the decomposition of cyanogen compounds, and stating that the black mass often observed as the result of the slow and spontaneous decomposition of hydrocyanic acid is, after having been boiled with nitric acid, found to consist of a graphitoid body, the author first directs attention to the formation of graphite in the blast-furnace process, and next states that M. Max Schaffner, director of the chemical works at Auszig (Bohemia), has succeeded in preparing graphite, fit for the making of lead-pencils, as a by-product of the manufacture of soda as carried on by Leblanc's process, the graphite being, in this instance, due to the splitting-up of the cyanide of sodium in a peculiar manner.

**Loss of Weight Platinum Crucibles Suffer by being Continually Ignited.**—Dr. F. Stolba.—The author has made a series of experiments on this subject, the results being that the rougher and more unpolished the surfaces of platinum crucibles are, the more readily they are acted upon by the flame of well-made Bunsen-burners, because the rough unpolished surface promotes the formation of a compound of carbon and platinum, which is partly consumed by the flame, partly mechanically carried upwards in the hot current of air, after having been detached from the crucible. The author found, by experiment, that, when a good platinum crucible was heated for twelve hours continually, it lost 0.016 grm. in weight, and its surface appeared as if etched, or as the well-known *moiré métallique*. This loss and alteration are not due to the presence and subsequent elimination of osmium, because the loss is greater of the crucible than the quantity of osmium contained in crude platinum. The brighter and more polished the surface of platinum crucibles and other platinum vessels exposed to ignition is kept, the better they will resist the deleterious action of the flame.

**Simple Method of Obtaining Sea-Sand Fit for Cleaning and Polishing Platinum Crucibles.**—Dr. F. Stolba.—Since the author resides at Prague (Bohemia), where, of course, sea-sand is not a material readily procured, he came upon the idea of applying to a sponge merchant, requesting him to beat some sponges and collect the sandy matter. In this way the author contrived to obtain a small quantity (some few drachms) of sea-sand, which he cursorily states to consist of about 80 per cent of carbonate of lime and 20 per cent of pure quartzose sand.

**Behaviour of Silico-Fluoride of Potassium with the Blowpipe-Flame.**—Dr. F. Stolba.—This salt, exposed to the blowpipe-flame on a piece of platinum wire, fuses at a moderate heat to a bead, which, while hot, is transparent, but becomes enamel-like on cooling. Continued heating causes the evolution of fluoride of silicon, whereby the bead shrinks, and yields, after cooling, a clear, transparent glass, which, having been qualitatively tested, was found to consist of fluoride of potassium and of silicate of potassa. The bead alluded to is, says the author, a very suitable substance for blowpipe tests. Silico-fluoride of sodium does not yield a transparent bead at all.

**Analysis of Alabaster Glass.**—Dr. F. Stolba.—This glass was that of a broken lamp-shade. It was very hard, and contained in 100 parts—Silica, 82.3; alumina, 3.2; lime, 3.3; potassa, 5.66; soda, 5.60. Fluorine, oxide of tin, phosphoric acid, and arsenic acid were not present.

**Crystallisation of Chlorate of Potassa by Fusion.**—Dr. F. Stolba.—When a tolerable quantity of this salt is cautiously fused in a large platinum crucible, and after being slowly cooled, the surface,

previous to its becoming quite solid, is pierced with a piece of thick platinum wire, and the still fluid mass poured out, the crucible will be found lined with crystals, which, according to the author, are of the same shape as those exhibited by the salt when crystallising from its aqueous solution.

**Analysis of a Peat-Ash from Benatek (Bohemia).**—Dr. F. Stolba.—The peat alluded to leaves from 20 to 22 per cent of ash, consisting, in 100 parts, of—Soluble in hydrochloric acid: Sulphate of lime, 20.45; carbonate of lime, 17.27; caustic lime (Aetzkalk), 22.40; magnesia, 0.47; alumina and oxide of iron, 13.35; sulphuret of calcium, 0.74. Insoluble in hydrochloric acid: Lime, 0.84; magnesia, 0.06; alumina and peroxide of iron, 3.62; silica, 19.79; water and carbonaceous matter, 1.01.

**Precaution to be taken when Paraffin is Applied as a Means of Preventing the Boiling Over of Fluids.**—Dr. F. Stolba.—Since paraffin has very little, if any, affinity at all for acid and alkaline fluids, it is often used to prevent, in chemical operations, the boiling over of liquids. The author states that, while engaged in preparing sulphurous acid gas by heating copper turnings and strong sulphurous acid, he used paraffin to prevent that mixture (very apt to boil over in consequence of the tumultuous evolution of gas) from boiling over; but, after awhile, an explosion took place, caused by the fact that the gas delivery-tube had become choked by the paraffin, which in molten state had been mechanically carried over by the sulphurous acid gas, and, on cooling in the gas delivery-tube, stopped the exit for the gas, and thus caused the destruction of the apparatus. In case, therefore, paraffin is used in such operations, the gas delivery-tubes should be wide, and the operator should pay attention if any paraffin becomes deposited in the tube.

**Manufactory of Peas-Pudding Sausages (Erbswurst) at Berlin.**—Dr. Dingler.—It appears that a Berlin cook, named Grünberg, has recently discovered a process by which a preparation of peas may be made so as to keep without becoming sour, and the Prussian Government has bought the secret of this process from the inventor, for a sum of £5555. The Prussian War Office has created an establishment, at Berlin, capable of producing daily 75,000 sausages made of this preparation, which consists of a mixture of bacon, peculiarly-prepared pea flour, onions, and other ingredients, inclusive of salt. The sausages are sent away packed in boxes containing from 100 to 600, weighing 1 lb. each, which are destined as food for the armies, and only requiring to be boiled in water for a very short time to be ready for the use of the soldiers. The daily ration of each being 1 lb., a quantity quite sufficient for each man. This establishment, only working for the armies, costs daily about £6000.

*Zeitschrift für Chemie von Beilstein*, No. 16, 1870.

This number only contains one original paper:—

**New Method of Quantitative Analysis.**—H. Carmichael.—As far as it is possible without the reproduction of a number of woodcuts, essentially necessary for the proper comprehension of the contents of this paper, we will try to give an account of the author's method of analysis. In the introduction to his paper, the author animadverts upon the fact that, on an average, the results of percentically-quoted analysis, made by experienced analysts, vary from 99.17 to 100.67, a difference of 1.5 per cent; or, when 1.5 grm. has been taken and weighed off, and the weighings during the operations been carried to 0.0001 grm., a variation of 225 units. As to the causes of these irregularities, the author states that they are chiefly, if not solely, due to the manipulations, among which decantation is one of the principal sources of error. The author then proceeds to describe, and illustrates by woodcuts, a series of ingeniously-contrived apparatus, the object of which, chiefly, is to render such operations as decantation, filtration, drying, and ignition of substances, readily and very accurately-executable operations, the author states that even a couple of milligrams of substance are sufficient for a complete analysis. The paper contains the following example of an analysis made by the author's method:—

	Quantities weighed off.				Found.			
MgO .. .. .	0.0690	..	..	..	0.0688	..	..	..
KCl .. .. .	0.1873	..	..	..	0.1852	..	..	..
NaCl .. .. .	0.0876	..	..	..	0.0900	..	..	..
	0.3439				0.3440			

Without having seen this method, and the apparatus required, it is difficult to judge of its merits. It is very probable, however, that, if the author's process is found to answer as well as he leads us to believe, the apparatus will soon be obtainable from the dealers in such articles, who are generally men well enabled to judge whether a novelty will become generally available for use.

*American Journal of Pharmacy*, November, 1870.

This number contains the following original papers and memoirs relating especially to chemistry and allied sciences:—

**Pulverisation of Camphor.**—W. Procter.—It is well known that camphor is easily reduced to powder by rubbing with a few drops of alcohol, but the powder so made will, after a short time, aggregate to crystals, which have to be rubbed down again. The author mixes with the powder of camphor so obtained, carbonate of magnesia, 10 grains to the ounce being sufficient; this powder never cakes or forms crystals.



**Crystallisation of Sulphocarbolate of Quinine.**—Dr. C. J. Rademaker.—Crude sulphocarbolic acid was saturated with plumbic carbonate, the sulphocarbolate of lead crystallised and decomposed with sulphate of quinine, the solution of sulphocarbolate of quinine filtered and evaporated, but it was found almost impossible to crystallise the salt, owing to the gelatinous condition of part of the solution, which adhered to the small amount of crystals formed; the gelatinous mass was re-dissolved in alcohol, but with no better result as regards the obtaining of crystals. The author then made a solution of definite strength, and obtained, after a length of time (some few weeks), large crystals of prismatic shape, which on analysis were proved to be sulphocarbolate of quinine, a salt freely soluble in water, not deliquescent, and but slightly soluble in alcohol.

**Amount of Arsenic in the Phosphorus of Commerce.**—Dr. C. J. Rademaker.—Since the author had frequently to prepare dilute phosphoric acid, according to the directions given in the U. S. P., he states that he always takes the precaution of passing a current of sulphuretted hydrogen through the solution, in order to free it from all substances precipitable by that agent from acid solutions, the result always being that by this operation sulphide of arsenic is thrown down; in order to estimate the amount thereof, 100 grms. of phosphorus were oxidised with nitric acid, the solution diluted, and the arsenic precipitated as sulphide,  $AsS_3$ , by means of sulphuretted hydrogen; the solution was allowed to rest for six days, after which the precipitate was collected on a filter and washed, transferred to a small evaporating dish oxidised with nitric acid, reduced by means of sulphurous acid to arsenious acid, again precipitated, but in the form of  $AsS_3$ , by means of sulphydric acid, the precipitate digested with ammonia to free it from adhering sulphur, the solution filtered, evaporated, dried, and weighed, and found to amount to 15 grains, or nearly 1 gramme of sulphide of arsenic.

**Sulphocarbolate of Zinc.**—Dr. A. B. Lyons.—The author first prepares crude sulphocarbolic acid by heating together 17 parts of strong sulphuric acid with 16 of carbolic acid; this mixture having been diluted with 10 times its volume of water is saturated with carbonate of lead; into the filtered solution of sulphocarbolate of lead, a quantity of pure granulated zinc, equal in weight to the carbolic acid employed, is introduced; at the end of 24 hours the solution will be usually found free from lead, giving no precipitate with sulphuric acid or potassium iodide; when the solution is in that condition it is decanted, heated to boiling, filtered, and evaporated to a small bulk to crystallise; the salt so prepared is quite free from sulphate, and yields fine large crystals free from any empyreumatic odour.

**Solubility of Glue in Glycerine.**—J. M. Maisch.—This paper contains a lengthy account of some experiments instituted by the author, who was called upon to act as expert in a suit involving the right to manufacture a composition for printing rollers in which sugar is wholly or partially substituted by glycerine, and since one of the attorneys (*Angus*, "barrister"), engaged by one of the parties to the suit, stoutly denied the solubility of glue in glycerine, and said that this was the result of experiments made, the author set to work, and the results of his carefully made experiments may be summarised as follows:—Glue is soluble, at the ordinary temperature, in a large proportion of glycerine; glue is permeable by glycerine, slowly at ordinary, more readily at an elevated temperature; glue swelled in consequence of the absorption of water remains unchanged in appearance under glycerine, that is to say, even if the glycerine should abstract the water, the former will take the place of the latter liquid, thus preventing the shrinking of the glue; glue, by continued digestion, dissolves completely in glycerine, gelatinising on cooling; the solution of glue in glycerine is accelerated by previous maceration in glycerine, and by increasing the temperature, and doubtless also by pressure; glue thoroughly permeated by water dissolves in hot glycerine about as readily as it does in hot water. The author throws out the valuable hint, that the property of gelatine of being soluble in glycerine might be turned to account to prepare a well-keeping standard solution of gelatine to be used for the assay of tannin-containing substances, since the aqueous solution of gelatine becomes very soon spoiled by standing after having been made.

## NOTES AND QUERIES.

**University of Giessen.**—"Vox" wishes to know where he can ascertain the course for obtaining degrees at the University of Giessen.

**Alkaline Fluorides.**—I should feel greatly obliged if you would inform me how the solutions of neutral fluorides of the alkalis are made, as I want the above to etch glass with. In looking over past numbers I cannot find anything that treats of them.—O. X. O.

**Dextrine—Lactic Acid.**—(Reply to "Carbon.")—To estimate the quantity of dextrine in a solution likewise containing glucose, Dr. Gentile determines the total amount of these bodies by means of a standard solution of potassium-cupric-tartrate, and then estimates the glucose with an alkaline solution of ferricyanide of potassium (red prussiate) which does not act upon dextrine; the difference of the two determinations gives the quantity of the dextrine. Consult the article on "Dextrin" in Dr. Watts's "Dictionary of Chemistry," vol. ii., p. 312, and following. The tests for lactic acid, which are, however, not very definite, you will find fully described in Dr. Miller's "Elements of Chemistry," 4th edition, vol. iii., p. 415. Our space will not allow us to transcribe the passages.

## MEETINGS FOR THE WEEK.

MONDAY, Dec. 5th.—London Institution, 4. Dr. Odling, F.R.S., "On Chemical Action." (Educational Course.)  
— Medical, 8.  
— Royal Institution, 2. General Monthly Meeting.  
TUESDAY, 6th.—Institute of Civil Engineers, 8.  
— Zoological, 9.  
WEDNESDAY, 7th.—Society of Arts, 8.  
— Geological, 8.  
— Pharmaceutical, 8.  
THURSDAY, 8th.—London Institution, 7.30. W. Mattieu Williams, F.C.S., "On Count Rumford and his Philosophical Work."  
— Royal, 8.30.  
— Royal Society Club, 6.  
FRIDAY, 9th.—Quekett Microscopical Club, 8.

## TO CORRESPONDENTS.

\*\* Vol. XXI. of THE CHEMICAL NEWS, containing a copious index is now ready, price 11s. 4d., by post, 11s. 10d., handsomely bound in cloth, gold-lettered. The cases for binding may be obtained at our office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our office, or, if accompanied by a cloth case, for 1s. Subscribers wishing to complete their sets of volumes are requested to apply to the publisher, who will give them information respecting scarce numbers and volumes. Vol. xxii. commenced on July 1st, and will be complete in twenty-six numbers. READING CASES, price 1s. 6d. each post free, may also be obtained at the Office.

A Subscriber from St. Petersburg.—The second part of the work is not yet published; it will be duly announced.

J. B. Barnes.—Received.

S. E. P.—The letter is too complicated for our pages.

**St. Bartholomew's Hospital.**—The LECTURESHIP OF CHEMISTRY in the Medical School of this Hospital being vacant, Gentlemen desirous of offering themselves as Candidates are requested to send their Applications and Testimonials to the undersigned on or before Friday, the 9th December next.

WM. HENRY CROSS, Clerk.

St. Bartholomew's Hospital.  
November 22, 1870.

## PRACTICAL CHEMISTRY.

Laboratory, 60, Gower Street, Bedford Square, W.C.

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# THE CHEMICAL NEWS.

VOL. XXII. No. 576.

## SPECTROSCOPIC NOTES.\*

By Prof. C. A. YOUNG, Ph.D.,  
Professor of Natural Philosophy and Astronomy in Dartmouth College.

*A New Form of Spectroscope.*—The instrument, a description of which follows, was designed for attachment to the equatorial of 6.4 inches aperture and 9 feet focal length, belonging to the observatory of Dartmouth College. It is specially intended for observations upon the solar spots and protuberances, and accordingly the principal object kept in view has been to combine a very high degree of power with compactness, lightness, facility of manipulation, and firmness and construction. Having the dispersive power of 13 prisms of heavy flint, each with an angle of  $55^\circ$ , it yet weighs less than 15 pounds, and measures over all 15 inches in length, 8 in breadth, and  $4\frac{1}{2}$  in height. It was made by Alvan Clark and Sons.

The accompanying plate (Fig. 1), taken from a photograph, gives a correct idea of its appearance and general arrangement. The collimator and observing telescope have each an aperture of  $\frac{7}{8}$ ths of an inch, and a focal length of 7 inches, which might advantageously have been increased to 12 inches were it not for the necessity of compactness.

The light from the slit after passing the collimator, is transmitted through the lower portion of a train of six prisms of heavy flint glass, each  $2\frac{1}{4}$  inches high, and having, as stated above, a refracting angle of  $55^\circ$ . A seventh *half-prism* follows, and to the back of this is cemented a right angled prism by which, after two total reflections, the light is sent back through the upper part of the same train of prisms, until it reaches the observing-telescope. This is placed directly above the collimator, and firmly attached to it. Finally, a diagonal eye-piece brings the rays to the eye in a convenient position for observation.

The instrument thus has the dispersive power of thirteen prisms, and even with the low magnifying power of only five on the observing-telescope, shows perfectly the lines of aqueous vapour, which make their appearance between the sodium lines when the sun is near the horizon. Of course, everything shown on the maps of Kirchhoff and Angstrom is readily seen with it, and many lines besides.

Its definition is very beautiful, and the only optical fault of the instrument seems to be a curvature of the lines, resulting from the shortness of the collimator.

After planning the instrument, I learned that the same idea of sending the light twice through the prisms by a right-angled prism at the end of the train had also occurred to Mr. Lockyer and others; but I do not know that it has yet been put in practice elsewhere.

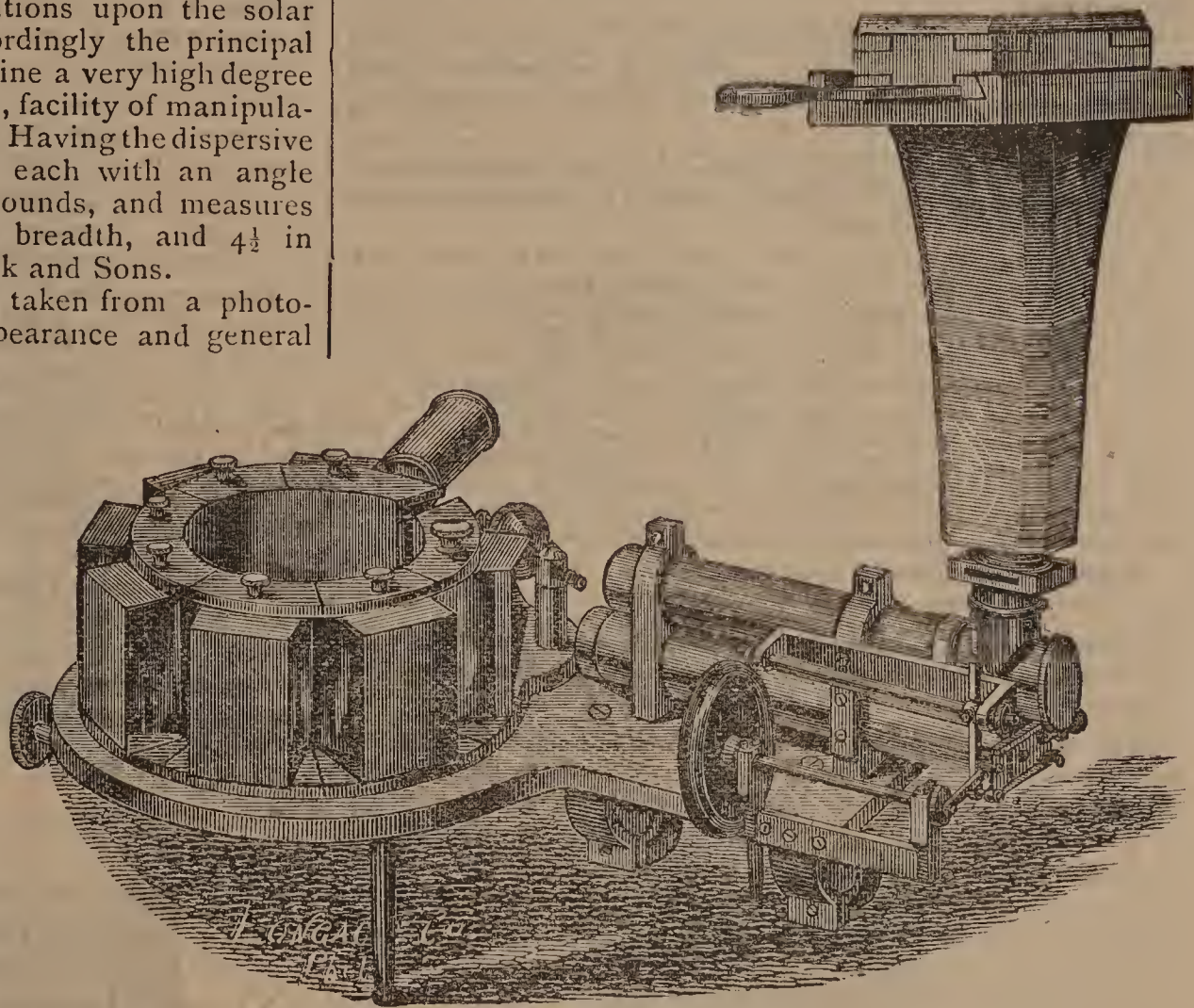
The prisms, for protection and convenience of handling, are set in frames of blackened brass. They are arranged around the circumference of a hollow cylinder of elastic gun-metal,  $3\frac{1}{4}$  inches in diameter, with stout flanges above and below, between which they are clamped by little

thumb-screws, so that they can be readily removed or transposed: it requires less than a minute to put the last prism with its reflector in place of any other of the train, thus reducing the dispersive power to any extent desired.

No particular care is required in placing the prisms, as a couple of narrow flanges were cast upon the cylinder near the top and bottom, and afterwards planed off to form true bearings for the backs of the prisms. They are thus always correctly set by being simply slid home before tightening the clamping screws.

The lower flange of the cylinder is attached to the base-plate by a screw directly under the middle of the front face of the first prism. Around this point as a centre the whole system of prisms is movable by means of a double threaded tangent-screw which brings the different portions of the spectrum into the field of view.

FIG. 1.



The adjustment of the prisms to their angle of minimum deviation is effected by a method devised by Mr. George Clark, which is exceedingly simple, and, if not theoretically exact, answers every practical purpose. The flanges between which the prisms are clamped, are sawed through between the prisms, and a portion of the cylinder, flanges and all, equal to an arc of about  $30^\circ$ , is cut out between the first prism and the last. On closing up or spreading open this gap by means of a suitable tangent-screw, the circumference of the circle around which the prisms stand is correspondingly enlarged or diminished. Probably, when the ends of this opening are drawn very near together, or spread very far apart, the cylinder is somewhat distorted, and a corresponding mal-adjustment of the prisms results; but if so the effect is very slight.

The instrument gives a perfect view of every part of the spectrum A to H: above *h*, however, when all seven prisms are used, there is a loss of light occasioned by a partial obstruction of the apertures of the collimator and telescope by the corner of the reflecting prism.

Were it important to secure the perfect cylindricity of the prism-frame through the whole range of adjustment, it could be easily done by merely fastening at the back of each prism a radial bar acting upon a central pin as in the arrangement first devised by Mr. Rutherford, and since adopted by Mr. Browning in his automatic spectroscope.

\* From advance-sheets of the *Journal of the Franklin Institute*. Communicated by the Editors.



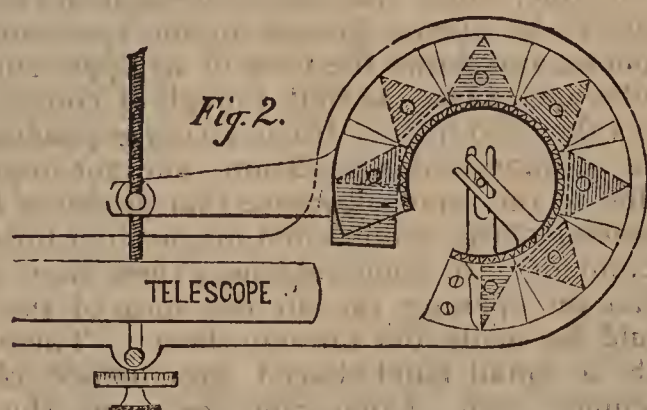
This plan of Mr. Clark's, doing away with all joints and hinges, has the great advantage of perfect firmness and solidity in every position of the instrument, an advantage hardly to be overrated in an astronomical spectroscope.

Had it occurred to me in season I might have made the instrument still simpler, firmer and perfectly automatic in its adjustment, by merely substituting for the first prism a *half prism*,\* like the last of the train, to which the right-angled reflecting prism is cemented.

Placing this first *half prism* with its front face perpendicular to the line of collimation it would never need to be disturbed; the flange of the cylindrical frame which carries the prisms would be firmly fastened to the bed-plate immediately beneath it, and the pivot joint at this place with the corresponding tangent-screw would be dispensed with. The only adjustment required would be that produced by the screw which is now used to adjust for minimum deviation by opening or closing the gap of the cylinder.

Of course this arrangement would reduce the dispersive power of the train by the amount of one prism, a loss easily made up by adding a degree or two to their refracting angles.

Fig. 2 exhibits the plan of the proposed arrangement, and requires no explanation, unless to remark that, for



the sake of distinctness, I have represented only two of the radial bars which may be used to render the adjustment accurate.

It might be better to place the face of the first prism not exactly normal to the line of collimation, in order to avoid repeated reflections between it and the object-glass of the collimator, which would be likely to produce a troublesome ghost, or the same thing might be accomplished by simply cementing the object-glasses of both collimator and observing-telescope, directly upon the front of the prism; this would make the instrument still more solid and compact.

The eye-piece of the instrument has an apparatus attached, which, however, thanks to the high dispersive power, I find unnecessary.

It was early proposed by Janssen to use a vibrating or rotating slit in order to make visible the form of a solar prominence, but as Zöllner has shown, the mere opening of the slit answers just as well, the light of the protuberance being diluted to precisely the same extent in either case.

It occurred to me, in connection with a suggestion of Professor Morton, that by interposing at the focus of the eye-piece a diaphragm which should move with the vibrating slit, the light of the neighbouring portions of the spectrum might be cut off and this dilution avoided. Mr. Clark has devised and constructed a very beautiful mechanical arrangement by which this simultaneous and accordant motion of slit and diaphragm is effected by the rotation of the small fly-wheel shown in Fig. 1.

But I find, that although seen in this way, the prominences appear very bright; yet the working of the apparatus always causes a slight oscillation of equatorial, which interferes with the definition of details, and I prefer to work with the slit simply opened. When the air is free from haze, the whole extent of a prominence 30,000

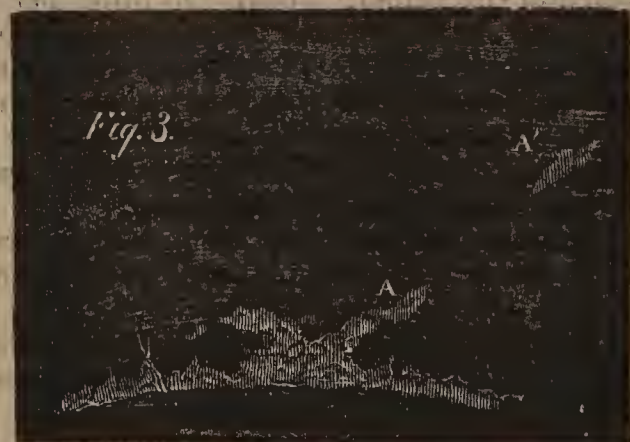
miles in height is readily examined through the C or F line, and the most delicate details reveal themselves, with a beauty and clearness of definition which even yet always surprises me, and speaks most emphatically for the exquisite workmanship of the 43 different surfaces by which the light is either refracted or reflected on its way from the slit of the collimator to the eye.

But, although I do not use the vibration of the slit and diaphragm, I find the mobility of the slit so convenient as to be practically indispensable. In examining the spectrum of a group of sun spots, for instance, it is very much easier to move the slit to the particular point we wish to observe than to move the solar image by the tangent screws of the equatorial.

*Photographs of the Solar Protuberances.*—The protuberances are so well seen through the F and 2796 (near G) lines, that it is even possible to photograph them, though, perhaps not satisfactorily with so small a telescope as the one at my command. Some experiments I have recently made show that the time of exposure, with ordinary portrait collodion, must be nearly four minutes, in order to produce images of a size which would correspond to a picture of the solar disc about 2 inches in diameter. This length of exposure demands a more perfect clockwork than my instrument possesses, and a more accurate adjustment of the polar axis than it had during the experiments, as well as a steadier condition of the atmosphere.

Thus far, therefore, I have not been able to produce anything which could properly be called a good picture. Negatives have been made which show clearly the presence and general form of protuberances, but the definition of details is unsatisfactory. This amount of success was reached upon September 28th, when impressions were obtained of two protuberances on the S.E. limb of the sun, and, slight as this success was in itself, I consider it of importance in showing the perfect feasibility of going much further with more sensitive chemicals, more delicate adjustments, and greater telescopic power. I was aided in the experiments by Mr. H. O. Bly, our local photographer, to whom are due my warmest acknowledgments for the interest, patience, ingenuity, and skill with which he assisted me.

We worked through the hydrogen  $\gamma$  line (2796 of Kirchhoff's scale), which, though very faint to the eye, was



found to be decidedly superior to F in actinic power. The photographic apparatus employed consisted merely of a wooden tube, about 6 inches long, attached at one end to the eye-piece of the spectroscope, and at the other carrying a light frame. In this frame was placed a small plate-holder, containing, for a sensitive-plate, an ordinary microscope slide, 3 inches by 1. The image of the prominence, seen through the open slit, is magnified and thrown upon this plate by the eye-piece. Fig. 1 shows the instrument with this apparatus attached.

It would be easy to improve this arrangement in many respects, and whenever I resume the subject I propose to do so.

As the equatorial, however, has been dismantled, to be put in order for the observation of the December eclipse, further attempts in this direction must be postponed until next spring.

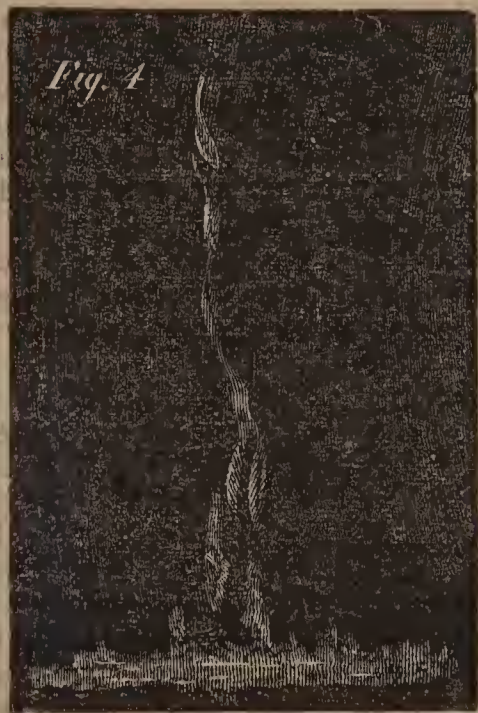
\* On returning from the Eclipse Expedition my instrument will be made automatic in accordance with this plan.



*Observations of the Solar Protuberances.*—Without prolonging this article with the detail of observations, I add a few of the results which have been obtained since September 10th.

About forty different prominences have been more or less carefully observed: sixteen have been sketched. Most of them fall, naturally enough, into the categories established by Zöllner and Lockyer, and are fairly represented by figures already published.

A few deserve especial mention, however. Fig. 3 represents a small one, which was observed upon the E. limb of the sun on September 14th, about 4.30 p.m. From the point marked A, which was very brilliant, a small fragment detached itself and rose towards A', enlarging in size and growing fainter as it rose. It disappeared (from faintness) in about twelve and a half minutes, at a distance of 2' 30" above the limb of the sun, as determined by the time, 8.5", which was occupied by the intervening space in passing over the slit of the spectroscope. Allowing for the



obliquity of the motion to the parallel of declination, the length of path passed over by this cloud was more than 90,000 miles, and the velocity above 120 miles per second.

Fig. 4 represents a prominence observed September 20th, at 4 p.m., on the S.E. limb. (Pos. S., 60° E.) It was a nearly vertical stream, made up of spindle-formed filaments, and had attained the enormous height of 3' 20", or 90,000 miles (determined, as in the case above-mentioned, by a time observation, corrected for inclination). It was very brilliant near the base, and at two or three other points along its length. At 4.30 it was nearly gone, only a few faint wisps of cloud remaining.

Another, observed on September 27th, at 4.10 p.m., and situated on the W. limb of the sun, is represented in Fig. 5. It was formed of separate, well-defined narrow



streamers, which appeared to consist of matter, first violently ejected, and then as violently deflected, by some force acting nearly at right angles. The altitude of the highest point was 1' 25", the length of the whole about 3' 30". I am unable to see how any mere projection from the sun could have produced such a form, and cannot help feeling that it indicates a *something* in which powerful currents may exist, even at such great elevations above

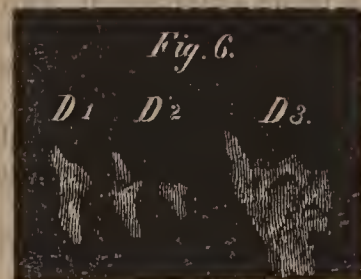
the solar surface; in short, an atmosphere extending far beyond the limits which calculation would seem to assign as possible. Is it wholly unlikely that, at such an enormous temperature, the law of Mariotte may fail so completely as to destroy the reliability of any computation that assumes it as one of the data?

Upon the next day the prominence still persisted, but the type was wholly changed: it was replaced by one of the mushroom-formed masses which are so common.

*Bright Lines.*—In the spectra of different protuberances, the following bright lines have been observed, the numbers referring to Kirchhoff's scale: C; D<sub>1</sub>; D<sub>2</sub>; D<sub>3</sub>; 1474; 1515; b<sub>1</sub>; b<sub>2</sub>; b<sub>3</sub>; b<sub>4</sub>; 1990; 2001; 2031; F; 2581.5; 2796; h—17 in all. On one occasion, September 27th, the base of a prominence on the N. W. limb, close to a spot just leaving the limb, exhibited as many as twelve or fifteen short bright lines between E and F, which are not included in the above enumeration, as I had not time to identify them. It is the only instance in which I have seen this phenomenon, more than once described by Mr. Lockyer.

I desire to call special attention to 2581.5, the only one of my list, by the way, which is not given on Mr. Lockyer's. This line, which was conspicuous at the eclipse of 1869, seems to be *always present* in the spectrum of the chromosphere, and shows the form of its upper surface or of a protuberance nearly as well, though of course not so brightly, as the 2796 line. It has no corresponding dark line in the ordinary solar spectrum, and not improbably may be due to the same substance that produces D<sub>3</sub>.

The reversal of the sodium and magnesium lines is not at all uncommon. In some instances these lines were so bright, that on opening the slit the form of the prominence could be made out through them. This was the case with a small hand-shaped prominence observed on September 27th. Comparing the form thus seen through D<sub>1</sub> and D<sub>2</sub>, with that given by D<sub>3</sub>, it appeared that the sodium line was sufficiently developed for observation only along the edge and at one or two bright points in the prominence, most brilliantly neither at its summit nor its base. Fig. 6 represents the appearance



(the slit was perpendicular to the sun's limb). The case was similar with the magnesium lines.

*Spectrum of Solar Spots.*—Several spots have been carefully examined at different times, most of them, in their spectra, gave evidence of unusual disturbances; but by far the most interesting phenomena were exhibited by a large group which was first observed near the E. limb on September 19th. Changes of wave length were frequent in its neighbourhood.

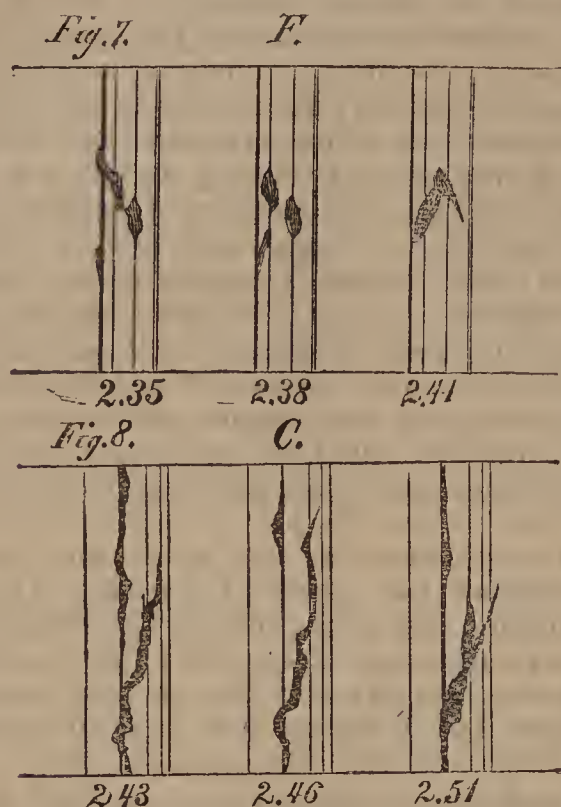
Figs. 7 and 8 represent the appearances assumed by the F and C lines respectively, at the times indicated below each figure, during an observation on the afternoon of September 22nd. The point where these changes of wave-length occurred was at the western edge of the penumbra. At other times similar changes were observed, but not so great or rapidly varying.

The calcium and titanium lines referred to in my note, published in the July number of the *Journal of the Franklin Institute* (CHEMICAL NEWS, vol. xxii., p. 218), were always conspicuously thickened in the nucleus spectrum.

The C and F lines were reversed in some portion or other of the group nearly every time I observed it. On September 22nd, the sodium lines were both reversed for several hours, while D<sub>3</sub> appeared as a dark shade. On September 28th, again, at 4 p.m., the southern nucleus of



the group (which at this time contained four large umbræ, besides many small ones), reversed all of the following lines, viz.: C; D<sub>1</sub>; D<sub>2</sub>; D<sub>3</sub>; 1474; b<sub>1</sub>; b<sub>2</sub>; b<sub>3</sub>; b<sub>4</sub>; F; 2796; and h. All of these were *conspicuous*, except 1474; D<sub>3</sub> and b<sub>3</sub> especially so, and the latter (a nickel

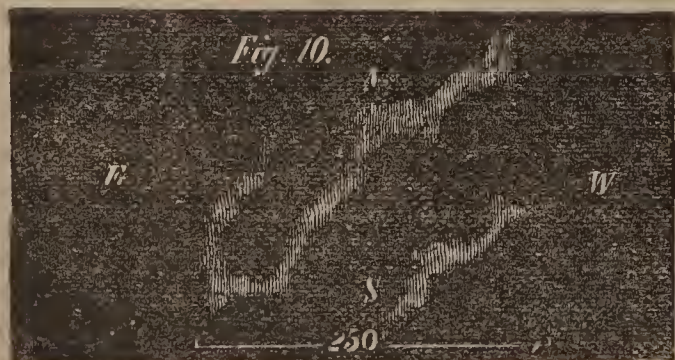


line) showed considerable changes of wave-length, alternate increase and diminution, which were not shared by its magesian neighbours, b<sub>1</sub>, b<sub>2</sub>, and b<sub>4</sub>.

At 4.05 p.m. the brilliance of the F line increased so greatly that it occurred to me to widen the slit, and to my great delight I saw upon the disk of the sun itself a brilliant cloud in all its structure and detail identical with the protuberances around the limb. Indeed, there were two of them, and there was no difficulty in tracing out and delineating their form. Fig. 9 represents them as they



were from 4.05 to 4.10; Fig. 10 gives the form at 4.15-20. They were then considerably fainter than at first. During the intervening ten minutes I examined the other lines of the spectrum, and found that the form could be distinctly made out in all the hydrogen lines, even in h;



but that the reversal of the other lines, including D<sub>3</sub>, was confined to the region immediately over the spot-nucleus, where the smaller but brighter cloud terminated abruptly; or, I might better say, originated. The larger one faded out at both ends. When the clock-work of the equatorial was stopped, the luminous cloud took 16.7 seconds of

time to traverse the slit which was placed parallel to the hour-circle. This indicates a length of at least 130,000 miles without allowing anything for the foreshortening resulting from the nearness of the sun's limb.

By 5 o'clock the clouds had nearly disappeared; a little rack alone remained.

At 4.20 I examined the spot with the equatorial, using the ordinary solar eye-piece. Nothing remarkable was to be seen—not the merest trace of the enormous masses of incandescent gas. It will be interesting to learn whether the earth responded to this magnificent eruption on the sun by any magnetic storm.

I may add that in the telescope this group of spots, from their first appearance, exhibited a strong yellowish tinge, which appeared to overlie all the central portion of the cluster. So conspicuous was it that several persons, unaccustomed to astronomical observation, noticed it at once before I called their attention to it. The penumbra of the group was unusually faint.

Hanover, N.H., October 3rd, 1870.

### ON THE NUCLEAR ACTION OF A SALINE CRYSTAL ON A SUPERSATURATED SOLUTION OF THE SAME SALT.

By CHARLES TOMLINSON, F.R.S.

BEFORE attempting to reply to the second part of Mr. Liversidge's paper (p. 253 *ante*), I must call upon him to get rid of what seems to me to be an illogical distribution of his argument, which I now proceed to expose.

I state that cold supersaturated solutions of *magnesian sulphate* were kept for some time over sulphuric acid in an exhausted receiver, when crystalline crusts of the normal salt were formed on the surface, and that these, by shaking, fell through the solution without acting as nuclei.

Mr. Liversidge replies to this statement by quoting one of Löwel's experiments on *sodic sulphate*, accompanied by Löwel's remark that "it is not the normal salt which is formed in allowing a supersaturated solution to evaporate spontaneously under cover, but the modified salt or that with seven atoms of water."

Mr. Liversidge remarks that such crystals are inactive, "which inactivity seems to be only explicable by accepting Löwel's analyses."

Now, granting for the moment, the relevancy of Löwel's experiment, I want to have it made clear to my understanding, that because sodic sulphate behaves in a certain manner, under certain conditions, magnesian sulphate must also behave in the same manner, under the same conditions.

I have no opportunity of consulting the reference to Löwel's first memoir without going into town, but my impression is that Löwel's experiment was not made for the purpose of determining the nuclear action of the modified sodic sulphate salt, but expressly for determining its hydration. All through this first memoir he accepts Faraday's analysis, and calls it the 8-atom salt; but in a *Note additionelle* he describes an experiment in which a boiling solution of sodic sulphate was placed, in company with calcic chloride, under the receiver of an air-pump, and kept there for days, and, if I mistake not, for weeks, until the whole of the liquid part had evaporated. Then from the lower part of the mixed crystalline mass he selected crystals from which he determined the hydration of the modified salt.

It will be seen from this statement, supposing it to be correct, that Löwel's experiment leads to a very different result compared with that in which crystalline crusts are formed on the surface of a long column of a supersaturated solution.



When a supersaturated solution of sodic sulphate is set aside and left undisturbed for weeks and months the liquid portion diminishes slightly in volume and crystalline crusts are formed in the neck of the flask just above the solution. This effect is best obtained by using a globular flask with a long, straight, cylindrical neck, a portion of which is occupied by the solution. On inclining the flask the solution may be made to wash over these crystals, and even to wash them down, when, in the latter case, they fall slowly through the solution, but in no case do they act as nuclei. I showed an experiment of this kind to a distinguished Fellow of the Chemical Society a few weeks ago. The flask had been kept on a window-ledge during some months: on inclining it the crystals in the neck were washed down, and they fell to the bottom of the solution without any nuclear action. On taking out the cotton-wool crystallisation of the normal salt immediately set in from the surface.

Solutions of magnesian sulphate are well adapted to the exhibition of this class of phenomena, as the crystals not only creep up the neck, but form on the surface, and both results are produced much more quickly than in the case of sodic sulphate.

Ammonium-phosphate also forms clear crystalline crusts in the neck of vessels containing supersaturated solutions of that salt. I have kept the solution in contact with the crust for days together without any perceptible kind of action. In order to see whether the crust was corroded by contact with the solution, I traced an outline of the crust in ink on the outside of the tube before bringing the solution into contact with the crust. After several days' contact I could not find any diminution in the magnitude of the crust or in the sharpness of its outline. Of course the solution, being supersaturated, could exert no solvent action on a salt of its own kind, just as in washing out the remaining colouring matter from a cone of refined sugar a saturated solution of white sugar is passed through the mould; it washes the sugar without dissolving it.

Now, in order to reduce the subject of this note to a practical issue, I have to propose two questions to the gentlemen who have opposed my views (whom, I beg to say, I regard not as opponents, but as friends and coadjutors in the pursuit of truth).

I. Are not the crystalline crusts that form in the neck of a vessel containing a supersaturated solution of sodic sulphate constituted like the normal salt with ten atoms of water?

II. Are not the crusts that form on the surface of long columns of a supersaturated solution of magnesian sulphate and creep up the neck of the vessel constituted like the normal salt, with seven atoms of water?

Unless these questions can be clearly and distinctly answered in the negative on the indisputable grounds of experiment and analysis, then I contend that the general proposition that the best nucleus that can be employed for bringing about the crystallisation of a supersaturated saline solution is a crystal of its own kind, is not true.

Highgate, N., December 5th, 1870.

On page 265, col. 2, line 29 from bottom, for "the surface-tension of the solution was lowered," read *increased*.

# ON THE COMPARATIVE INFLUENCE OF VARIOUS SUBSTANCES IN PREVENTING THE DECOMPOSITION OF ORGANIC SUBSTANCES.

By Dr. F. CRACE CALVERT, F.R.S.

On reading the interesting article by Dr. Sansom, in your issues of the 18th and 25th ult., on "Evidence Concerning the Germ Theory of Fermentation afforded by the Action of Certain Substances when Suspended in the Air," it occurred to me that it might prove of some service to

many of your readers if I were to lay before them the results of a series of experiments I made some eighteen months ago, to ascertain the comparative powers of various substances ordinarily used as antiseptics.

Before entering into the details of the experiments, I would remark that there is a considerable confusion in the use of the terms antiseptic, disinfectant, and deodoriser, against which it is well to guard. A deodoriser is a substance which removes unpleasant or noxious odours; a disinfectant one which prevents the spread of infection; and an antiseptic one which prevents the substance with which it is in contact from entering into a state of fermentation or putrefaction. As examples of deodorisers may be mentioned chloride of manganese and sulphate of the protoxide of iron. Among antiseptics are chloride of mercury, chloride of zinc, chloride of sodium, arsenious acid, some of the essential oils, carbolic acid, and cresylic acid. Disinfectants are of two classes—those which act by oxidation, destroying the organic substances which give rise to the infection (such are permanganate of potash, bleaching powder, and nitric acid); and those which act, as Dr. Sansom shows, by their presence, undergoing no decomposition themselves, but appearing to poison or render innocuous the germs of disease. To this class belong camphor, and sulphurous and carbolic acids. Of course all the substances above mentioned do not possess exclusively the properties of the class to which I have referred them, but I believe that their predominant characteristic is that which I have assigned them.

With a view of carrying out the statement made in the first paragraph, I made two distinct series of experiments; the first consisted in placing in bottles (not corked) solutions of albumen and flour paste. To these I added various proportions of some of the substances patronised at the present time as antiseptics, and the following table shows the results obtained:—

Antiseptic employed.	Percentage of antiseptic.	Time in which it acquired an offensive odour. Temperature from 70° to 80° F.	
		Albumen.	Flour-paste.
McDougall's disinfecting powder ..	5	11 days	25 days
Carbolic disinfecting powder .. ..	5	{ Remained sound	{ Remained sound
Chloralum (made lately) .. ..	2	9 days	—
Chloride of zinc ..	2	15 days	—
Chloride of lime ..	5	16 days	14 days
Permanganate of potash .. ..	5	—	—
Tar oil .. ..	2	11 days	25 days
Carbolic acid ..	2	{ Remained sound	{ Remained sound
Cresylic acid ..	2	{ Remained sound	{ Remained sound
None .. ..	—	5 days	7 days

The above table clearly shows that the only true antiseptics are carbolic and cresylic acids, and these results coincide with those obtained by Mr. William Crookes, F.R.S., Dr. Angus Smith, F.R.S., and Dr. Sansom. For these two acids continued their action till the albumen solution and paste dried up.

It follows that if deodorisers are merely required for removing the noxious odour from any mass of matter in a state of decay or decomposition they may be used with advantage; such are chloride of manganese, chloride of lime, sulphate of iron, permanganate of potash, chloralum. But if it is desirable to prevent the decomposition of organic matter (and, in my opinion, this is the point to be aimed at, for prevention is better than cure), then carbolic and cresylic acids are the only two substances which attained this object.

As the products given off from decaying organic matter are well known to facilitate the decomposition of similar classes of substances to themselves, if placed in close



proximity (no doubt by the atmosphere conveying the germs), I made the following experiments with the view of ascertaining which of the undermentioned substances would possess the most active power in destroying such germs, and thus preserving the animal substance from decay. At the bottom of wide-mouthed pint bottles I placed a known quantity of each of the antiseptics, and suspended over them by a thread a piece of sound meat, and, by daily examination, it was easily ascertained when the meat became tainted or putrid. The following table gives the results obtained:—

Antiseptic used.	Became tainted.	Putrid.
Permanganate of potash .. ..	2 days	4 days
Chloralum .. .. .	2 „	10 „
McDougall's disinfecting powder	12 „	19 „
Chloride of lime .. .. .	14 „	21 „
Tar oil .. .. .	16 „	25 „
Chloride of zinc .. .. .	19 „	—
Carbolic disinfecting powder	Did not become tainted, but dried up and became quite hard.	
Carbolic acid .. .. .		
Cresylic acid .. .. .		

#### ABSTRACT OF A PAPER ON THE ABSORPTION OF SULPHUR BY GOLD, AND ITS EFFECTS IN RETARDING AMALGAMATION.\*

By WILLIAM SKEY,  
Analyst to the Geological Survey of New Zealand.

THE author of this paper, while recently investigating the causes of the reported loss of gold during the process of extraction at the Thames Gold Fields, observed that much of this loss could scarcely be referred to any of those causes generally supposed operative for it. He therefore tested the actual condition of the natural surfaces of numerous specimens of Thames gold, in respect to their behaviour with mercury, and examined, further than has hitherto been done, into its comportment with several of those substances likely to be associated with it in a natural way.

The results of these examinations have been minutely recorded in this paper, while the following is a short abstract of them:—

The author finds—

(1.) That numerous samples of bright, clean-looking gold, of all degrees of fineness, refuse to amalgamate on any part of their natural surfaces, though taken directly from the reef and untouched by hand.

(2.) That on such surfaces sulphur is always present.

(3.) That native gold, or gold in a pure state, readily absorbs sulphur from moist sulphuretted hydrogen or sulphide of ammonium, and absorbs it directly when administered in boiling water.

(4.) That surfaces so treated refuse to amalgamate, though no apparent change can be observed in their aspect.

(5.) That gold so affected is rendered amalgamable by wasting in an open fire, except copper is present to the extent of seven per cent (or perhaps less), while the same effect is produced by the contact of cyanide of potassium, chromic and nitric acid, and chloride of lime acidified.

(6.) That this absorption is altogether of a chemical nature.

(7.) That sulphates of iron in presence of air and water decomposed various metallic sulphides common to auriferous reefs, in such a manner as to liberate sulphuretted hydrogen.

The action of sulphuretted hydrogen upon gold, in rendering it non-amalgamable when placed in contact with mercury, was demonstrated with striking effect by the author before the members of this Society.

\* Read before the Wellington Philosophical Institute, September 17th, 1870.

From these results the author has been led to suppose that a large area of the natural surfaces of native gold is covered with a thin film of an auriferous sulphide, and that the greater part of the gold which escapes amalgamation at the battery is represented by that portion of this sulphurised gold which has remained unabraded during the processes of milling or extraction from the reef; the state of the gold, rather than that of the mercury, therefore, being the greatest impediment to thorough amalgamation.

In addition to these results, the author communicated others, relative to the effect of solutions of sulphuretted hydrogen and sulphide of ammonium upon platinum. In rendering it non-amalgamable, he believed a sulphide of the metal had formed in each case, since chromic acid rendered it again amalgamable. He also stated that this metal is also so affected by ammonia or the fixed alkalis that it will not amalgamate, except in presence of a mineral acid; from which he suspects platina is capable of superficial oxidisation when in contact with alkaline substances, even at common temperatures.

The author found that his samples of gold were not affected by the alkalis in this manner, except in the case of one from Victoria, a singularity from which was argued the presence of palladium in this particular sample.

#### ON LIQUIDS OF HIGH DISPERSIVE POWER.

By WOLCOTT GIBBS, M.D.,  
Rumford Professor in Harvard University.

OF the liquids which have hitherto been proposed for the construction of prisms, bisulphide of carbon unquestionably presents the greatest advantages. It is cheap, colourless, and unites a moderately high mean refractive to a very high dispersive power. By tacit consent, a prism of 60° filled with this liquid has come to be adopted as a sort of standard. The disadvantages of the bisulphide are equally well known, and I have spent no little time and labour in the endeavour to find a liquid with a still higher dispersive power, less volatile, less sensitive optically to changes of temperature, and less offensive in odour. In these efforts I have not been altogether successful, no one liquid examined possessing all the qualities desired. Many organic liquids with high dispersive powers are difficult to prepare in a state of purity, and speedily become discoloured by absorption of oxygen from the air. Such are oil of cassia, the colourless oil obtainable from balsam of Peru and others. The thallic alcohol of Lamy\* is far too costly. The solution of silico-tungstate of sodium†, of meta-tungstate of sodium‡, and of soluble tungstic acid§ as obtained by dialysis, all promised good results from their extraordinary densities, but all proved difficult to prepare in a state of purity, and extremely easy of decomposition.

A solution of phosphorus in bisulphide of carbon, has, according to Messrs. Dale and Gladstone||, a dispersion of 0.225¶, or nearly one and a half times as great as bisulphide of carbon alone, but becomes turbid on exposure to sunlight from the formation of amorphous phosphorus. It occurred to me that, by dissolving sulphur with the phosphorus, the formation of amorphous phosphorus might be prevented, and experiment proved that this was the case. The solution, as thus obtained, has a pale yellow colour, but is perfectly clear, and undergoes no change by the action of light even when long continued. I have been in the habit of preparing it by dissolving 1 part of dry flowers of sulphur and 2 parts of phosphorus in 4 or 5 parts of bisulphide of carbon, and filtering the

\* *Ann. de Chim. et de Phys.*, 4th series, vol. iii., p. 373.

† *Ann. de Chim. et de Phys.*, 4th series, vol. iii., p. 5.

‡ Shiebler, in *Journ. für Prakt. Chim.*, vol. lxxxiii., p. 273.

§ Graham, in *Journ. Chem. Soc.*, vol. ii., p. 318.

|| *L. and E. Phil. Mag.*, vol. xviii., p. 30.

¶ The number 0.225 is the difference between the indices for the extreme red and violet rays.



liquid through a well-dried ribbed paper filter, which is easily done. The refractive and dispersive power of the solution will, of course, vary with the quantity of phosphorus and sulphur dissolved. By a gentle heat, the whole, or nearly the whole, of the bisulphide of carbon may be driven off, a liquid compound of sulphur and phosphorus remaining, which has so high a mean refractive power that it cannot be employed with prisms having a refractive angle of more than  $45^{\circ}$ — $50^{\circ}$ . The same end may, however, also be attained by continually adding phosphorus to a saturated solution of sulphur in bisulphide of carbon, in which phosphorus appears to be soluble without limit.

With a strong and probably saturated solution of sulphur in  $\text{CS}_2$ , the angle between Li and D was  $0^{\circ} 50' 10''$ . When phosphorus was added, the angle was  $2^{\circ} 25' 30''$ , the refracting angle of the prism being  $60^{\circ}$ . In this last case the angle between  $\text{Na}_1$  and  $\text{Na}_2$  was  $0^{\circ} 2' 20''$ . The spectrum was perfectly clear, the definition of the dark lines leaving nothing to be desired. In consequence, however, of the yellow colour of the liquid there is always a marked absorption of the violet end of the spectrum.

In working with the above-described solution, I have employed hollow glass prisms with refracting plates cemented on with a mixture of glue and molasses. These were found to be perfectly tight, and to last for months without change. The great disadvantage in the use of a solution of sulphur and phosphorus consists in the danger of breaking the prisms; the liquid taking fire spontaneously when it has been a few seconds in contact with any porous material like wood or paper. On the other hand, however, the large quantity of sulphur present prevents the fire from spreading, a drop placed upon a piece of wood leaving, after combustion, only a charred spot. When not in use the prisms should be kept in an iron pot with a tight cover. In this manner I have employed and preserved two during a long and hot summer. The viscid, or rather oily, nature of the solution serves to prevent, to a great extent, the formation of ascending and descending currents from slight changes of temperature; and, when the prisms are well shaken before use, the definition remains perfect for a long time. In my spectroscope, the prisms rest upon a plate of glass instead of upon one of metal.—*American Journal of Science.*

## PROCEEDINGS OF SOCIETIES.

### CHEMICAL SOCIETY.

Thursday, December 1st, 1870.

Professor WILLIAMSON, F.R.S., President, in the Chair.

THE following gentlemen were elected Fellows:—H. E. Armstrong, Ph.D.; R. Barklie; W. L. Carpenter; T. M. Crafts, Professor of Chemistry in Cornell University; J. Dewas; T. Farries; R. Mallet, F.R.S., and Dr. Ogg.

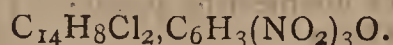
Mr. PERKIN, F.R.S., read a paper "On Some Derivatives of Anthracene." This was a detailed account of some anthracene derivatives, more particularly of the products resulting from the action of sulphuric acid upon dibrom- and dichloranthracene.

*Dichloranthracene*.—It is most conveniently prepared by passing chlorine gas over benzol, holding about one-fifth its weight of purified commercial anthracene in suspension, until the mixture becomes a crystalline mass. The product is then brought on a linen filter, drained, washed with cold benzol, dried, and then further purified by distillation and subsequent re-crystallisation from benzol. Thus obtained it appears in golden-yellow needles. The mean of several analyses gave 67.91 per cent C, 3.34 per cent H, and 28.70 per cent Cl,

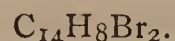
which numbers agree perfectly with the formula of Græbe and Liebermann,  $\text{C}_{14}\text{H}_8\text{Cl}_2$ .

*Dichloranthracene*, when gently heated, sublimes in beautiful needles, which may be obtained of considerable size. It is fluorescent in the solid state as well as when in solution.

When a boiling solution of dichloranthracene in benzol is added to a similar solution of picric acid, the mixture assumes a dark orange-red colour, and on cooling becomes filled with small bright red needles. These consist of a compound of dichloranthracene and picric acid. A determination of the dichloranthracene in this body gave numbers closely approximating to those required by the formula—



*Dibromanthracene*.—This product was prepared by Græbe's process. It was, however, purified first by distillation and then by crystallisation from benzol. Thus obtained it is of a golden-yellow colour. It gave on analysis numbers closely agreeing with those required by the formula—

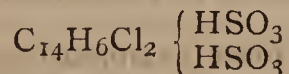


Like dichloranthracene this body produces a beautiful red compound with picric acid.

*Action of Sulphuric Acid on Dichloranthracene*.—Dichloranthracene, when submitted to the action of fuming sulphuric acid, dissolves, forming a bright green solution, and is at the same time converted into a sulpho-acid.

To prepare this acid, one part of dichloranthracene is added to about five parts of fuming sulphuric acid, and the mixture heated for a short time on the water-bath. It is then gradually poured into several times its bulk of water and treated with carbonate of barium until all the sulphuric acid is neutralised. The acid solution when filtered off from the sulphate of barium is evaporated to a small bulk. When sufficiently concentrated, it becomes, on cooling, a shiny mass of minute orange-yellow coloured crystals, which may be drained on a porous tile.

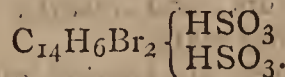
This acid has not been analysed, but from the composition of its salts evidently possesses the formula—



Mr. Perkin therefore proposes to call it disulphodichloranthracenic acid. It is easily soluble in water, from which it is precipitated upon the addition of a little concentrated sulphuric or hydrochloric acid. It possesses a strongly acid taste and character.

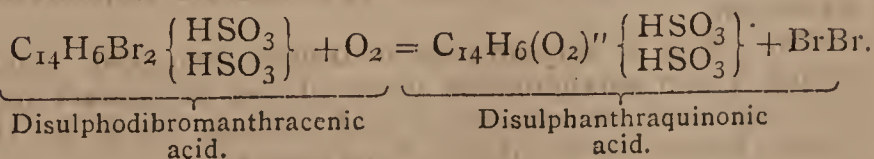
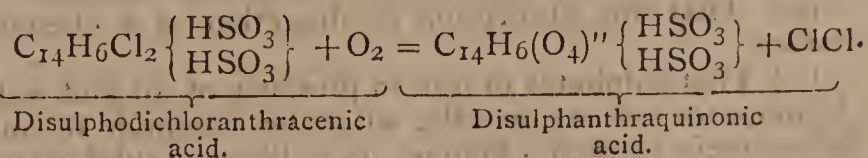
The acid forms salt with sodium, barium, calcium, and strontium. The barium salt is remarkable for its insolubility in hydrochloric acid.

Dibromanthracene yields with strong sulphuric acid an analogous disulphodibromanthracenic acid—



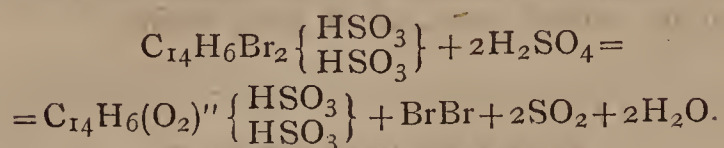
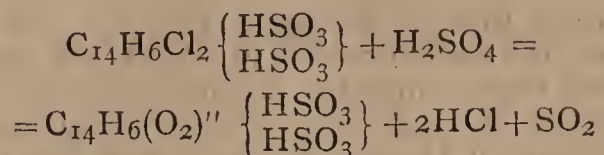
Its sodium, barium, &c., salts are similar to the salts of disulphodichloranthracenic acid.

*Oxidation of Disulphodichlor- and Disulphodibromanthracenic Acid*.—These sulpho-acids, when subjected to the influence of oxidising agents, rapidly decompose, exchanging their chlorine or bromine for oxygen, and are thus converted into disulphanthraquinonic acid.



An analogous result is also obtained by treating them with concentrated sulphuric acid, the following reactions taking place:—





Anthracene, when pure in large crystals, shows a beautiful fluorescence, and so do many of the anthracene products, though curiously their solutions are comparatively poor in this respect. Anthracene and dichloranthracene in the state of vapour are not at all fluorescent, and, moreover, a ray of light sent through the length of about four inches of the vapour of either body still retained its power of rendering fluorescent bodies luminous.

The experiments in this direction are, however, not yet concluded. On sealing up anthracene in a long vacuum-tube with platinum poles, and allowing the discharge from an induction coil to pass through the tube, nothing particular is observed except the beautiful fluorescence of the crystals of anthracene. On examination with the spectroscopic, the light showed carbon and nitrogen lines, the latter arising from the presence of a little air in the tube. Upon heating the tube, however, somewhat strongly, so as to volatilise the hydrocarbon, the ordinary colour of the discharge changed to a magnificent deep azure blue, and what is remarkable is that this blue light, when examined with the spectroscopic, is perfectly continuous, and consists of blue with a little green.

Dichloranthracene, when treated in a similar manner gives an analogous result, but suffers a good deal of decomposition, anthracene changing but little. These curious results do not appear to be due to the fluorescent character of the substances employed, as naphthalene produces a similar effect, the blue light, though not so intense, being continuous. It must be observed, however, that this hydrocarbon undergoes considerable change, becoming brown and oily.

Anthracene, heated in a vacuum-tube in the same way, gives a greenish blue light, showing faint carbon bands.

On exposing a solution of disulphodichloranthracenic acid to the light of one of the recent displays of the Aurora Borealis, it was very strongly illuminated, as might be expected. Moonlight, on the other hand, had no perceptible effect upon it, nor yet an alkaline solution of esculine.

Mr. Perkin illustrated his interesting communication by a series of most beautiful experiments.

The society then adjourned to December 15th.

#### LONDON INSTITUTION.

On Thursday, the 1st inst., Professor MORRIS, of University College, delivered a lecture "On Gems and Precious Stones," in which the science of the mineralogist, chemist, and geologist, was combined with the industrial lore of the miner, lapidary, diamond-cutter, and agate-stainer. Having glanced at the different systems of classification adopted by mineralogists, the lecturer noticed the distinctive physical characters of the substances known as precious stones, calling special attention to the crystalline form, cleavage, hardness, and refractive power of the diamond. He stated that the diamond was the only representative among gems of the elementary bodies. It was a form of carbon, and, under certain conditions, it could be readily burned into carbonic acid gas. A curious calculation showed that the great Koh-i-noor if burned would furnish just enough gas to charge from twelve to fourteen bottles of soda-water. The optical properties of the diamond had led Newton to regard it as a combustible body long before the actual combustion of the gem had been effected. The dull varieties of the diamond known as "carbonado"

and "boort" were largely used in the arts, for steel-engraving, glass-cutting, rock-boring, and other purposes. The mineralogical and geological features of the diamond beds of India, Brazil, Borneo, South Australia, and South Africa were described, and the frequent association of diamonds with itacolumite, gold, and rutile was referred to as a subject worthy of careful investigation. Other precious stones, such as the sapphire, ruby, emerald, beryl, topaz, jargon, garnet, spinel, and turquoise, were treated of successively, reference being made to their chemical composition, their physical properties, and their application to decorative and industrial purposes. Artificial gems, "doubles" made of glass, faced with slices of the real stones, and artificially coloured agates were noticed, and the characters by which they might be distinguished were plainly indicated. The lecture was illustrated by a valuable and interesting collection of objects. Messrs. Blogg and Martin contributed a unique series of uncut diamonds, exhibiting perfect crystalline forms, some large diamonds from South Africa, and one remarkable specimen embedded in the "cascallio" from a diamond bed in Brazil. Professor Tennant contributed a large collection of diamonds in the natural state, and also some curious specimens of quartz that had been mistaken for diamonds. Through the kindness of Messrs. Hunt and Roskell, the lecturer was enabled to exhibit a fine series of gems and models of the great South-African diamond before and after cutting. To Mr. James Gregory, again, the lecturer was indebted for a collection of ornamental minerals, models of most of the famous diamonds, and specimens of the gravel and rocks associated with the diamonds in South Africa.

On Monday afternoon Dr. ODLING delivered his sixth lecture "On Chemical Action." The circumstances modifying combustion were discussed and illustrated by a remarkable series of experiments with the oxyhydrogen blowpipe, and the hot and cold blast.

#### NOTICES OF BOOKS.

*Die Spectralanalyse in ihrer Anwendung auf die Stoffe der Erde und die Natur der Himmelskörper.* Gemeinfasslich dargestellt, von Dr. H. SCHELLEN, Director der Realschule I. O., zu Cöln. Braunschweig: Druck und Verlag von George Westermann, 1870.

*The Spectrum Analysis, in its Application to the Matter of the Earth, and to the Elucidation of the Nature of the Heavenly Bodies.* A popular treatise, by Dr. H. SCHELLEN, Director of the Realschule I. O., in Cologne. Published by George Westermann, Brunswick, 1870.

THIS is, undoubtedly, the most thorough work on the subject of spectrum analysis which has yet appeared.

Some fifty pages are, in the first place, devoted to the sources of light—such as the oxyhydrogen, the magnesium, and various sorts of electric lights, as well as the common flames and Bunsen burners.

The nature of light, as illustrated by the more readily studied phenomena of sound, and the general laws of reflection, refraction, and dispersion, are then discussed in some fifty more pages.

The spectroscopic is then fully described and illustrated with the phenomena of optical phosphorescence and selective absorption. This portion of the work occupies some seventy pages, and is full of new valuable matter, some of which we shall presently describe more in detail.

Next to this comes the sun spectrum and the Fraunhofer lines, with the discoveries of Bunsen and Kirchhoff, and the observations of Janssen and others as to the aqueous lines. A full discussion of the phenomena of sun spots then follows, profusely illustrated with many new engravings admirably executed. This takes us about fifty pages further.

The solar prominences next receive attention, and here we have a full account of the observations of De la Rue

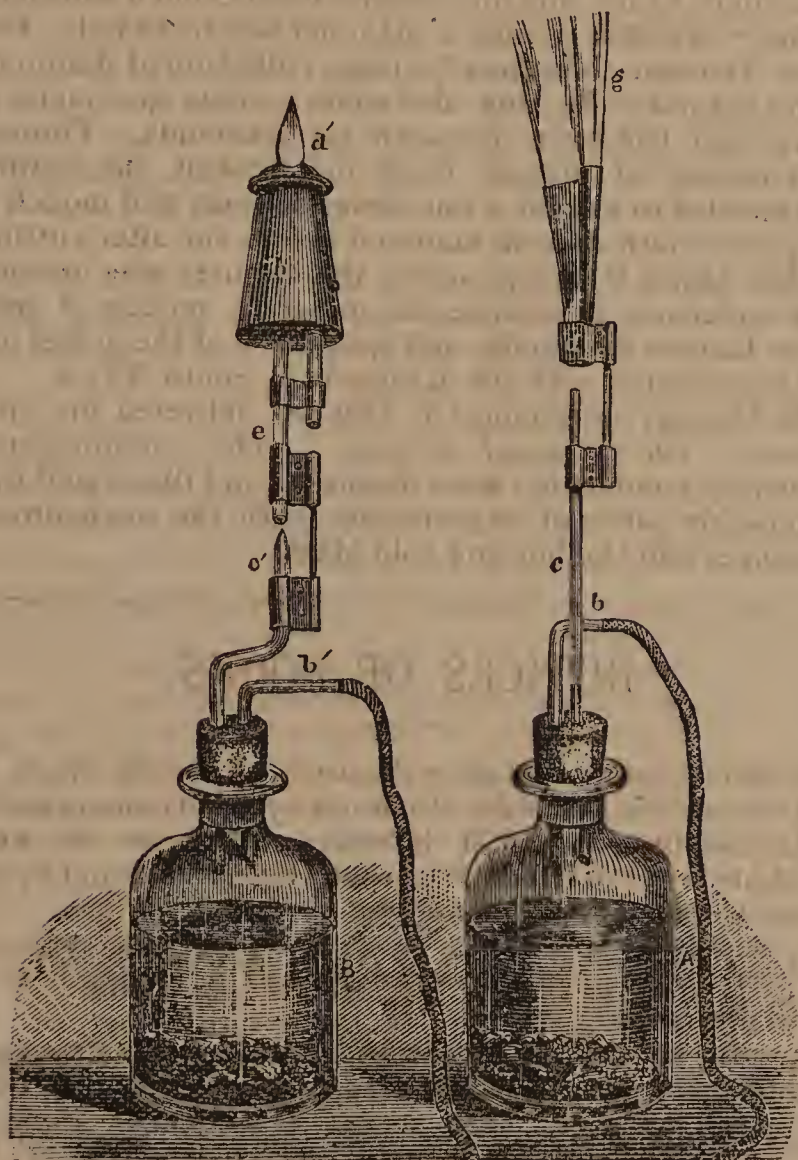


in 1860, with copies of his photograph, and of all the similar work accomplished in 1868 by Vogel, Tennant, Janssen, and others, as also the discoveries of Lockyer and Huggins. Here, also, are a vast number of the most interesting illustrations, and nearly one-hundred pages are devoted to this subject.

The next hundred pages are devoted to a full description of instruments, methods, and results, in connection with the study of stellar, nebular, cometary, and meteoric spectra; and, lastly, we find a few pages on the spectra of lightning and the aurora.

The entire work is eminently characterised by that thoroughness which is the eminent merit of German treatises, and nothing is alluded to which is not fully explained.

Thus we were disappointed to find in Roscoe's otherwise excellent book on this same subject a figure of Bunsen's apparatus for illustrating selective absorption, which was neither self-explanatory nor accompanied by



any description. Here, however, we find a much clearer figure supplemented with a full account, from which the action of this curious and ingenious arrangement becomes at once manifest.

This is of so much interest that we have reproduced the figure on a smaller scale, and here give it with a sufficient description. A and B are two flasks containing zinc and hydrochloric acid mixed with a solution of salt. The hydrogen evolved is thus filled with a fine spray of salt. Pipes *b* and *b'* lead into these flasks the ordinary illuminating gas, which mingles with the salt-charged hydrogen, and escapes by pipes *c* and *c'*, each of which, by a sort of locomotive exhaust action, carries with it a large amount of air into the pipe above, from which the mixture passes into burners, the first of which, *f*, is of a scoop shape, and makes a strong flame, which is to serve as the background to the other. By adjustment of the relative amounts of hydrocarbon gas and hydrogen, the flame, *g*, is made very intense, while *d* is rendered as cool as possible. By this means the light from *g* is well absorbed in traversing *d*, and this later appears as a black flame when seen against *g* as a background.

Portraits of Bunsen, Kirchhoff, Huggins, and Secchi, in the shape of excellent woodcut plates, are interspersed through the book, which has, besides, two coloured plates and 158 woodcut illustrations, a few of which we have seen before in some of Hachett's publications, but the greater portion are entirely new and of great value.

## CORRESPONDENCE.

### THE PRESERVATION OF STONE.

*To the Editor of the Chemical News.*

SIR,—In his last letter to you Mr. Church commences by adducing another argument against the originality of his own proposal, and concludes with the following statement—"The legal questions as to patents which Mr. Spiller raises I do not feel to be within my province to discuss." Perhaps not, but this will have to be done by deputy, as I am advised to dispute the validity of the patent for a "Combined Process," which merely unites your own and my inventions, without any superadded feature of novelty to constitute an independent claim.

During the present year I have upon two occasions applied my superphosphate process, exactly in accordance with the instructions which I gave in the text of a paper "On the Decay of Stone; its Cause and Prevention," read at the Dundee meeting of the British Association, September, 1867, and printed at page 123 of your sixteenth volume. The public should be free to use the mixed mono-calcic and baric phosphates as therein described by me (not patented), and we shall soon know what plea can be raised in support of this recent attempt at monopoly.—I am, &c.,

JOHN SPILLER.

London, December 3rd, 1870.

### MAGNETIC POWER EVOLVED BY A BATTERY.

*To the Editor of the Chemical News.*

SIR,—Last week I said that no electro-motor had ever yet been constructed with a thoroughly scientific knowledge of the elements of the question. Let me justify myself by enumerating these elements—the mutual relations of which, to each other, has never yet been thoroughly investigated. Indeed, thoroughly to investigate them would require a lifetime, and could only be done by large co-operation. They are, then,—

1. The kind of battery to be used.—Strange as it may seem, different kinds of batteries have very different magnetic effects in particular combinations, and laws deduced from the use of one battery cannot be applied to another. The reason, no doubt, is that when the intensity of different batteries varies, the effect of the reactions and polarisations produced in them differ very much. For instance, Bunsen's batteries (and Daniell's, if used in the same experiments, give totally different laws.
2. The size of the plates in the battery.
3. The number of cells as producing more or less electro-motive power, but with a consumption of zinc varying as the square of the intensity produced.
4. The size of wire.
5. The shape of wire, whether round, flat, or square.
6. The length of wire and number of ranges of spires on coil.
7. The number of derivations of circuit.
8. The form of construction of magnet, whether bar, horse-shoe, with two, three, or more poles, whether what the French call *aimants boiteux*, &c., &c.
9. The weight and number of magnets.
10. The relation of length to diameter of magnets.



11. The size, shape, and mode of application of the soft iron armatures.

12. The length of stroke.

13. The best kind of commutators.

And finally, and above all, the most beneficial adjustment of each of these in reference to the others.

We have an infinite source of force. Can we avail ourselves of it economically? Even the most essential element of the question, namely, how the magnetic force varies in regard to the intensity ( $i$ ) and length of current ( $l$ ), has not yet been decided. *Quot homines, tot sententiæ.* The prevailing opinion is that the energy varies as  $l^2 \times i^2$ . Some say that it varies rather as the simple powers than as the squares of these two quantities. My own opinion, formed from the consideration of numerous experiments, is inclined to the conclusion that the energy to be obtained from a current may be made to vary, according to different circumstances, in proportion to almost any powers of  $l$  and  $i$ , but that if we secured such conditions as should give a maximum of force, the magnetic energy of a battery would be found to vary (nearly, but not quite, as the square of the power of conveying matter by electrolysis, and of the power exercised by a wire over a magnetic needle, namely) as  $l^2 \times i^2$ . But whether it varies as  $l \times i$  or as  $l^2 \times i^2$ , or as any other powers of  $l$  and  $i$ , the conclusion remains the same, that  $l \times i$ , and consequently any power of  $l \times i$ , may be increased by skill without assignable limit.—I am, &c.,

H. HIGHTON.

Putney, December 5, 1870.

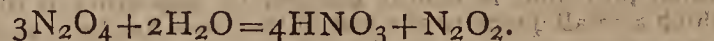
## THE REACTION BETWEEN WATER AND NITROGEN TETROXIDE.

To the Editor of the Chemical News.

SIR,—I do not wish to revive in your columns a rather unimportant discussion which arose at the Chemical Society out of some expressions used by Mr. E. T. Chapman in describing a determination of nitric oxide. But as any reader of the brief report sent to you, and of Mr. Wanklyn's comments, who was not present at the discussion, would suppose me to have called in question some familiar and well-established facts, I shall be obliged if you will insert a few lines of explanation.

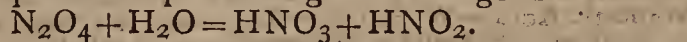
First, let me repeat what I stated twice in the course of the discussion, that I do not doubt, and have never doubted, the possibility of converting nitric oxide into hydrogen nitrate by the action of an excess of oxygen and water.

Next, as to the only point on which I ventured to differ from Mr. Chapman, and upon which, as far as I was concerned, the discussion turned. What is the reaction which takes place between water and nitrogen tetroxide? Mr. Chapman's view, for which he claimed the authority of a formidable list of text-books, is that these substances react to form hydrogen nitrate and nitric oxide, according to the equation



If this representation were correct, the complete conversion of the nitric oxide into hydrogen nitrate would be almost instantaneous, and would be simultaneous with the disappearance upon contact with water of the red fumes formed on mixing this gas with excess of oxygen.

But, in fact, at the ordinary temperature, and in the presence of much water, when the red fumes have disappeared, the liquid contains not hydrogen nitrate only, but a mixture of nitrate and nitrite in equivalent proportions. The equation representing the change is



Afterwards, by degrees, the hydrogen nitrite is oxidised to nitrate, but so slowly that if, even after some interval, the amount of oxygen that has been absorbed is measured, it is found to be just what is required to form nitrate and nitrite, and less by one-third than the amount required to yield nitrate only.

The rate of the subsequent change depends upon the temperature and concentration of the acid liquid, and probably, also, the nature of the change, since a cold dilute solution may be simply oxidised, as hydrogen sulphite would be oxidised, by the superjacent and dissolved oxygen, while a warmer or more concentrated solution would be partially decomposed with evolution of nitric oxide.

But I see no reason for believing that at any temperature near the ordinary temperature the production of nitrite does not form an integral part of the reaction.—I am, &c.,

A. VERNON HARCOURT.

Christ Church, Oxford,  
December 3rd, 1870.

## MISCELLANEOUS.

**Stone Waterproofing.**—At the recommendation of Professor Abel, Chemist to the War Department, the process invented by Messrs. Gay and Co., of Alton, Hants, for waterproofing and preserving stone and other buildings, is, by the order of the Office of Works, to be applied to the decayed stonework of the Houses of Parliament. *Journal of Society of Arts.*

**Precaution to be taken in the use of Phosphorus for the Absorption of Oxygen from Gaseous Mixtures.**—Dr. Commaille states that when phosphorus comes in contact with a solution of caustic potassa, even at the ordinary temperature, phosphuretted hydrogen is given off, and if, therefore, phosphorus be employed to absorb oxygen from a gaseous mixture contained in an eudiometer tube or bell-jar, into which previously a solution of caustic potassa had been introduced for the purpose of removing from the said gaseous mixture carbonic acid, the result will be that, if the piece of phosphorus be only wetted by the potassa solution, the quantitative estimation of the bulk of the gaseous mixture will become a failure in consequence of the evolution of phosphuretted hydrogen gas. The author states that a series of experiments made by him prove that the increase in bulk of the gaseous mixture is, even at a low temperature, rather considerable, and at summer temperature, after two or three days, the gaseous mixture, when coming into contact with free air, ignited spontaneously when the piece of phosphorus fastened to platinum wire had dipped for a few millimetres depth into the potassa.

**Preparation of Ultramarine Test-Paper.**—The great sensitiveness of artificially-made ultramarine for even very weak acids has been turned to account by applying that pigment to prepare a test-paper especially suited for the rapid detection of the presence of free acids in such salts as sulphate of alumina, alum, and other similar compounds. The ultramarine intended for this use should be that known commercially as No. 1; it should first be mixed with some water collected on a filter, and then thoroughly washed with some boiling distilled water, and afterwards incorporated with a mucilage made of 1 part of selected Irish moss, previously washed with cold water, boiled with about 30 parts of distilled water; the pigment thus obtained is uniformly painted over best filtering paper, and, after drying, cut up into strips, as is usual for litmus-paper, and preserved in a glass-stoppered bottle. In order to test the ultramarine, it is necessary to prepare a perfectly neutral alum in the following manner. Alum of commerce, by preference, potash alum, is dissolved in from 8 to 10 times its weight of boiling water, and this solution is poured into twice its bulk of alcohol at 80 per cent. The alum separated after complete cooling is collected, redissolved in boiling water, and the solution again poured into the same quantity of fresh alcohol of the same strength; the alum which separates on cooling is collected on a filter, and, after having been washed with alcohol, dissolved in water; a drop or two of this solu-



tion should not discolour the ultramarine, while its almost instantaneous discolouration should follow on its being touched with a drop or two of very dilute sulphuric acid, 1 part of strong acid to from 50 to 60 parts of distilled water.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

*Monatsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin*, June, 1870.

This number contains the following original papers and memoirs on subjects relating to physico-chemical and collateral sciences:—

**Relation Existing between the Hemiedric Crystalline Shape and the Thermo-Electric Properties of Iron Pyrites and Grey Cobalt.**—Dr. G. Rose.—This lengthy essay, illustrated by a series of engravings, treats especially on the crystallography of two peculiar kinds of minerals, and on the mode in which the crystalline form affects the thermo-electric properties of these substances. Cobalt glance, or grey cobalt, is a rather rare mineral, found especially in Sweden, and consisting, in 100 parts, of—Sulphur, 20.08; arsenic, 43.46; cobalt, 33.10; iron, 3.23;—total, 99.87.

**Reduction of the Annual Curves of Temperature to the Conditions upon which they are Naturally Based.**—Prof. Dove.—A meteorological essay.

**Contribution to our Knowledge of Meteorites.**—C. Rammelsberg.—This very exhaustive memoir contains the following sections:—Analysis of meteorites; separation of nickel from iron; extraction and determination of meteoric iron in such meteorites as are chiefly composed of stony matter; analysis of the silicates; on meteoric iron; on the pallasite from Brahin (Russia); on the chondrites from Poltusk, Richmond, and Iowa. The main result of the author's labours is, that the four chondrites analysed by him only contain two silicates—the mono-silicate, or olivine, and the bisilicate, or bronzite.

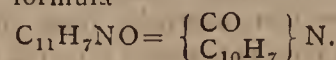
**Further Investigations on Methyl-Aldehyde.**—Dr. A. W. Hofmann.—This paper chiefly contains the results of a comparative investigation instituted by the author to ascertain how far the experiments and views held by M. Aimé-Girard (published in *Comptes Rendus*, vol. lxx., p. 623), on the methyl-aldehyde, are correct, and how far these researches agree with those instituted by the author. In this essay, the author chiefly treats on the sulphuretted methyl-aldehyde, and states that the assumption of a tri-molecular constitution for that substance leads to far more simple formulæ than when the constitution of that body is taken to be di-molecular, as has been done by M. Aimé-Girard. There is added to this paper an appendix treating on the—

**Sulphaldehyde of the Ethyl Series.**—This portion of the paper is devoted to the record of a series of experiments on the vapour density of the sulphaldehyde of ethyl, the formula of which has been usually taken as  $C_2H_4S$ . The author, however, finds that the proper formula for this body is  $C_6H_{12}S_2$ ; its vapour density, as compared with hydrogen gas, is 90, and as compared with air, 6.25. The author states that there exists an undoubted analogy between sulphomethyl-aldehyde and the sulphaldehyde of the ethyl series, but there is a great difference between the ethyl-metalddehyde and the metalddehyde of the methyl series. The vapour density of metalddehyde,  $C_2H_4O$ , was found to be 22 as compared with hydrogen, and 1.52 as compared with air.

July, 1870.

**Aromatic Cyanates.**—Dr. A. W. Hofmann.—The author refers briefly to his discovery of the body now named phenyl-cyanate; at the time of its discovery (about twenty years ago) it was called anilicyanic acid. This substance is obtained when the diphenyl-carbamide is heated with phosphoric acid, but this reaction is not suited for its preparation in large quantities. While engaged with his experiments on the essential oils of mustard, the author thought that the decomposition of phenyl-urethan might be turned to account for the preparation of phenyl-cyanate. When phenyl-urethan is treated with methylic, ethylic, or amylic alcohols, there are formed phenyl-urethans of the methyl, ethyl, and amyl series. The phenyl-carbaminic acid ether yields, when heated, although a portion escapes decomposition, alcohol and phenyl-cyanate,  $C_6H_{11}NO_2 = C_3H_5NO_3 + C_2H_5O$ . When phenyl-urethan is heated with anhydrous phosphoric acid, phenyl-cyanate is obtained in larger quantity. The distillate is a volatile liquid, boiling at  $163^\circ$ ; its vapour is irritating to the eyes; sp. gr. at  $150^\circ$ , 1.092; vapour density, as compared with hydrogen, 59.5, as compared with air, 4.13. When a glass rod, moistened with triethyl-phosphine, is immersed into phenyl-cyanate, much heat is evolved, and the entire mass becomes solid, exhibiting beautiful crystals. The author then gives a

description of some homologues of phenyl-cyanate, and among these is tolyl-cyanate, a liquid which has a strong refractive power and an irritating smell; it boils at  $185^\circ$ ; vapour density, as compared with hydrogen, 66.5, as compared with air, 4.61. The tolyl-cyanate exhibits, with triethyl-phosphine, the same reaction as the phenyl-cyanate. Xylol-cyanate, obtained from xylol-urethan, is a liquid boiling at  $200^\circ$ ; vapour density, as compared with hydrogen, 73.5, as compared with air, 5.10. Naphthyl-cyanate, obtained from naphthyl-urethan by distillation with anhydrous phosphoric acid, is a heavy colourless liquid, nearly inodorous at the ordinary temperature, and boiling at about  $270^\circ$ ; formula—



*Journal für Gasbeleuchtung*, October, 1870.

**On Hydrotimetry.**—M. Grahn.—This paper contains a detailed description of a method for the quantitative determination, by volumetric analysis, of the mineral substances in water. Titrated solutions of soap, oxalate of ammonia, nitrate of baryta, and nitrate of silver are used. This method of analysis was first proposed by MM. Boutron and Boudet, and has been chiefly employed in France for testing the water supplied by the water companies, for whose use it is especially adapted.

**Application of Coke as Fuel for Domestic Purposes, and on the Best Construction of Stoves for Coke.**—A. Buhe.—This long paper, which is illustrated with a series of engravings, contains a series of interesting experiments on the combustion of coke; the vitiation of air in rooms by its combustion; the best mode of constructing the stoves, and on the the most convenient size of the fuel. For stoves and kitchen fire-places, the author considers that it would be desirable for gas-works to sell the coke, broken up, by means of properly constructed machinery, into lumps about the size of walnuts.

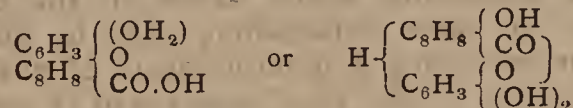
**Water Supply of Paris.**—Dr. N. H. Schilling.

**New Project of Water Supply for Berlin.**—Dr. N. H. Schilling.

*Annalen der Chemie und Pharmacie*, October, 1870.

The original papers relating to chemistry are the following:—

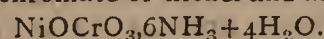
**Constitution of Phloridzine.**—H. Schiff.—The author first alludes to the action of dilute acids upon phloridzine,  $C_{21}H_{24}O_{10}$ , which is thereby split up into glucose and phloretine. This latter substance is, when acted upon by a boiling solution of caustic potassa, split up into phloretinic acid and phloro-glucose. The paper further contains a detailed account of the proper formula for denoting the constitution of phloretine, of which the two following formulæ are given:—



To ascertain which of these two formulæ is the most trustworthy, the author instituted a series of experiments for the purpose of testing the mode of combination of phloretine with acetylene, by acting on the former body with chloracetyl or acetic anhydride. He also describes the mode of preparation, properties, and constitutional behaviour of the following bodies:—Diacetyl-phloretine,  $C_{15}H_{19}(C_2H_3O)_2O_5 + H_2O$ ; pentacetyl-phloridzine,  $C_{21}H_{19}(C_2H_3O)_5O_{10} + H_2O = C_{31}H_{38}O_{16}$ ; triacetyl-phloridzine,  $C_{21}H_{21}(C_2H_3O)_3O_{10} + H_2O$ ; acetyl-phloridzine; caramel of phloridzine; acetyl-rufine; phloridzin-anilide; phloretin-anilide; mono-acetyl phloridzin-anilide; triacetyl phloridzin-dianilide; tribenzoyl-phloridzine.

**Hydrate of Protoxide of Nickel.**—H. Teichmann.—The author has studied the behaviour of the protoxide of nickel with ammonia and with carbonate of ammonia. He first calls attention to a fact, which, he says, is not mentioned in any work on chemistry—viz., that when the protoxide alluded to is precipitated from its saline combination at the boiling-heat of the aqueous solution, the resulting precipitate retains acid which cannot be removed by a continuous washing with water, but the precipitate obtained from nitrate of nickel becomes, after long-continued washing, freed from acid; and if other salts of the protoxide of nickel are employed, the impure precipitated hydrated protoxide is readily purified by dissolving it in ammonia to which a small quantity of a salt of that base has been added.

**On Chromate of Protoxide of Nickel, and on the Double Chromate of Protoxide of Nickel and Ammonia.**—E. A. Schmidt.—This paper treats chiefly on the labours of MM. Freese, Malaguti, Sarzeau, and others, on the salts just named. The author has made a series of analyses which prove that the formula of chromate of protoxide of nickel is  $3NiO \cdot CrO_3 + 6H_2O$ , and not, as stated by M. Malaguti and others,  $4NiO \cdot CrO_3 + 6H_2O$ ; but the salt is only formed as long as the protoxide of nickel is in excess, for, when the chromic acid prevails, a salt of the following composition,  $5NiO_2 \cdot CrO_3 + 12H_2O$ , is formed. The formula of the double chromate of nickel and ammonia is—



**Action of Ammonia on  $\alpha$  Chloro-Propionic and on  $\beta$  Iodo-Propionic Acid.**—W. Heintz.—This essay is divided into the following sections:—Behaviour of ammonia with ethylen-chloropropionic acid; behaviour of ammonia with ethylen-iodopropionic acid; behaviour of alcoholic ammonia with ethylen-iodopropionic acid; behaviour of aqueous ammonia (liquid ammonia) with ethylen-iodopropionic acid.

**Diglycolamide Nitrate of Silver.**—W. Heintz.—After first referring to his researches on the combination of diglycolamidic and nitric

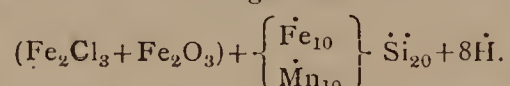


acids, the author states that diglycolamide nitrate of silver is analogous in composition to dilaetamide nitrate of silver. The former body is a crystalline salt, exhibiting a rhombic shape, insoluble in alcohol and water, and decomposed by heat, leaving metallic silver. Composition, in 100 parts—Carbon, 11.71; hydrogen, 1.46; silver, 52.68; nitrogen, 6.83; oxygen, 27.32. The author also describes the lead and copper salts of diglycolamido-nitric acid.

**Double Phosphate of Oxide of Copper and Soda.**—J. Weineck. —This paper reviews the labours of Dr. Rammelsberg on some salts of phosphoric acid (published in Poggendorff's *Annalen*, lxxviii., p. 383 and following. The author describes at length, the preparation, properties, and percentual composition of a salt which, in 100 parts, consists of—Phosphoric acid, 38.32; oxide of copper, 46.45; soda, 8.84; water, 6.75.

**Researches on the Isomerism of the Benzol Series.**—(Twelfth paper.)—F. Beilstein and A. Kuhlberg.—This paper treats on the isomeric toluidines, and is divided into the following sections:—Paratoluidine; meta-toluidine; ortho-toluidine.

**Analysis of Pyrosmalith.**—Dr. F. Wöhler.—Pyrosmalith is, according to the author, a rare mineral, only met with in the iron mines of Nordmarken, Sweden. The author quotes the analysis made of this mineral, in 1815, by Dr. Hissinger, and observes that the quantity of chlorine found by that *savant* is probably too low. The analysis now made by the author gives, for the composition of pyrosmalith, the following result, in 100 parts:—Silica, 36.42; protoxide of iron, 22.91; protoxide of manganese, 22.52; peroxide of iron, 5.10; perchloride of iron, 9.73; water, 3.32. The mineral contains, therefore, oxychloride of iron (14.88 per cent = 6.53 per cent chlorine) combined with a double silicate of the protoxides of iron and manganese. Formula—



**Presence of Urea in Bile as a Normal Constituent of that Fluid.**—O. Popp.—This paper, chiefly of physiological importance, contains the detailed account of the means of separating urea from bile.

**Chromate of Chromic Oxide.**—O. Popp.

**Some of the Products of Conversion of Phenol.**—L. Barth.—This lengthy essay contains an account of the author's experiments on testing the action of fusing caustic potassa upon phenol and the various products resulting therefrom.

**Bromo-Phenol-Sulpho Acids.**—C. Senhofer.—This monograph is divided into the following sections:—The bromine substitution-products of phenol-para-sulpho acid; the bromine substitution-products from phenol-meta-sulpho acid.

**Preliminary Notice on some of the Derivatives Obtainable from Gallic Acid.**—O. Rembold.—This notice treats on a body obtained by the author by first causing arsenic acid to act upon gallic acid at 120°, and next acting upon the insoluble body thereby generated with sodium amalgam, which is insoluble in water. The author is engaged with further experiments on this subject.

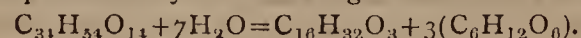
**On Saliretine.**—K. Kraut.

*Sitzungsberichte der Königlich Bayerischen Akademie der Wissenschaften zu München*, vol. ii., No. 2, 1870.

This number contains the following papers and memoirs relating to physico-chemical and collateral sciences:—

**Resin contained in the Tampico Jalap.**—Dr. Spigatio.—The author says that, in addition to the well-known and officinal jalap-root, the produce of the *Ipomœa purga* of Dr. Wenderoth, there has been imported of late, from Mexico, a new kind of jalap-root, under the name of Tampico jalap, Mr. D. Hanbury\* having described this root as the produce of the *Ipomœa simulans*, belonging to the same natural order as the other plants which produce jalap-roots—viz., *Convolvulaceæ*. The author instituted a series of experiments with the view of comparing the properties of the resins contained in the Tampico (the name of a seaport town and river of Mexico) and ordinary jalap-roots. The Tampico resin he calls tampicine, and the resin contained in the ordinary jalap-root, convolvuline. Tampicine is obtained by first exhausting the Tampico-root with water, and then dissolving the resin by means of alcohol; after evaporation of that fluid, the residue is purified by boiling with water; the resin is re-dissolved in alcohol, and the solution decolourised with charcoal. Tampicine agrees generally with convolvuline, as regards its properties, but it is distinguished from convolvuline by being soluble in ether, a property also possessed by jalapine (the resin met with in the root of the *Ipomœa orizabensis*), which, however, differs in its elementary composition. The alcoholic and ethereal solutions of tampicine exhibit a weak acid reaction to test-paper. Like convolvuline, tampicine is converted, by the action of bases, into an acid soluble in water, the elements of that liquid being thereby taken up. The author calls this acid tampicinic acid. Tampicine also resembles convolvuline in being a glucoside, which, by the action of dilute acids, is split up into sugar and a kind of fatty acid, tampicolic acid. Tampicine is soluble in acetic acid, and even at boiling heat is not split up into sugar and tampicolic acid; water precipitates the tampicine unaltered from its acetic acid solution. It is far more sensitive for heat than convolvuline, and cannot, without decomposition, be kept, even at 100°, for any length of time. The melting-point of tampicine is 130°; the formula, dried over sulphuric acid in vacuum, is  $\text{C}_{84}\text{H}_{54}\text{O}_{14}$ ; while the formula of convolvuline is, according to Dr. Mayer,  $\text{C}_{81}\text{H}_{50}\text{O}_{16}$ . Tampicinic acid is an amorphous, yellowish

coloured, brittle mass, void of odour, and exhibiting a sour, bitterish taste; attracts moisture from the air; is readily soluble in water and alcohol, but not in ether; its aqueous solution is a strongly acid fluid which decomposes alkaline carbonates, but that solution is not precipitated by any saline or metallic solutions, excepting those of acetate of lead and bichloride of mercury, which produce a faint turbidity, while a solution of basic acetate of lead causes a bulky, white, flocculent precipitate. Tampicinic acid, heated upon a piece of platinum foil in contact with air, burns, and leaves no residue. The formula of this acid is  $\text{C}_{31}\text{H}_{60}\text{O}_{17}$ ; it is generated from tampicine by the assimilation of  $3\text{H}_2\text{O}$ . Convolvulinic acid is, according to Dr. Mayer,  $\text{C}_{31}\text{H}_{60}\text{O}_{16}\frac{1}{2}\text{H}_2\text{O}$ . Tampicolic acid, when pure, is a snow-white coloured crystalline body, void of smell, of an acid taste, readily soluble in alcohol, but less so in ether; it melts, when submitted to heat, forming an oily fluid which produces a similar stain on paper to oil; on cooling, it becomes a hard, white-coloured stearic acid like mass. The alcoholic solution of this acid decomposes alkaline carbonates. The salts this acid forms with alkalis (potassa and soda) are soluble in water; its other combinations with bases are insoluble in that liquid. The formula of tampicolic acid is  $\text{C}_{16}\text{H}_{32}\text{O}_3$ , while the formula of convolvulinic acid is  $\text{C}_{13}\text{H}_{24}\text{O}_3$ . The process of the splitting-up of tampicine can be represented by the following formula:—



The author finally states that, according to his experiments, the medicinal use of tampicine is not to be recommended, its action upon the human organism being less sure, and by no means the same as that of convolvuline.

**Researches on the Action of the Electrophor.**—W. von Bezold.—The contents of this long and exhaustive memoir may be summarised as follows:—The electricity generated by rubbing the upper surface of the resin-plate of the electrophor exerts a diffusing action upon the lower or bottom resin-plate. If the primary excitation is sufficiently strong, the negative electricity of the lower plate forces its way through the layer of air existing between it and the resin-plate, and thereby causes the production of electric sparks. At the same time, the electricity primarily generated becomes partly fixed to the upper plate; and this process lessens the activity of the electricity of the disc, and also prevents electrical action between the two plates. The negative electricity of the disc, called forth by diffusion, remains in the disc, and can be made active by the removal of the disc. The efficiency of the instrument depends greatly upon the fact, that, when the disc is in position, it is in circumstances highly favourable to intense inductive action.

## NOTES AND QUERIES.

**University of Giessen.**—"Vox's" best plan is to go Giessen and follow the legitimate course of studies, and so obtain the degree.

**Pyrotechny.**—Can any of your readers recommend a thoroughly practical work on pyrotechny in either French or German, if there is not such a one in English? Also, where the apparatus can be had.—ERNEST J. WITHEFORD.

**Turkey Red.**—I shall take it as a favour if any of your readers would kindly tell me how this new Turkey red, from aurine (rosolic acid), is prepared for the use of paper printers. Aurine is changed by alkalis into a crimson, but I wish to know how this crimson is precipitated.—MAGENTA.

**Alkaline Fluorides.**—Reply to O.X.O.)—When hydrofluoric acid is saturated with potassa and evaporated to dryness, a deliquescent and difficultly crystallisable compound is obtained, which can be intensely heated without decomposition; its solution acts upon glass. The salt is decomposed by sulphuric acid and also by chlorine, hydrofluoric acid being evolved.

**Crith.**—The word "crith," proposed by Dr. Hofmann, was a very convenient one to express the weight of a litre of hydrogen, and has been adopted by some chemists. However, most teachers, I believe, now prefer to use Dr. Williamson's standard volume of 11.2 litres in making calculations with gases. I have been cudgelling my brain for some time past to find a euphonious word to express this volume. Will you allow me in the columns of your influential journal to draw the attention of our classical friends to this subject, and to ask them for suggestions?—TEACHER.

## MEETINGS FOR THE WEEK.

MONDAY, 12th.—London Institution, 4. Dr. Odling, F.R.S., "On Chemical Action." (Educational Course.)

— Medical, 8.

— Royal Geographical, 8.30.

TUESDAY, 13th.—Institute of Civil Engineers, 8.

— Photographic, 8.

— Ethnological, 8.

WEDNESDAY, 14th.—Society of Arts, 8.

— Microscopical, 8.

THURSDAY, 15th.—London Institution, 7.30. W. Mattieu Williams, F.C.S., "On Count Rumford and his Philosophical Work."

— Royal, 8.30.

— Royal Society Club, 6.

— Chemical, 8. W. H. Perkin, F.R.S., "On some New Derivatives of Coumarin."

\* *Journal of the Linnæan Society*, vol. xi.



# THE CHEMICAL NEWS.

VOL. XXII. No. 577.

## ON THE SEWAGE QUESTION.\*

By EDWARD C. C. STANFORD, F.C.S.

I HAVE been requested by the Committee of the Sanitary Section of the Philosophical Society to remind the Section of the origin of its existence; and, after the great variety of excellent papers read in this Section last year, it is, perhaps, as well to remember that we grew out of the Sewage Association of Glasgow, and that the subject which that Association met to discuss is still, even more than it was then, one of the most important, and the most interesting, as it confessedly is also still the most difficult problem of the day.

I have much pleasure in recording our early labours, because they were not without an important result. After a great number of discussions, where every possible variety of opinion was expressed, and where most of us commenced with the usual strong prejudice in favour of sewage by water carriage, we actually did pass *unanimously*, at the close of the session in 1868, the following resolution, first in committee and then in open meeting:—

“That, in the course of the discussions which have taken place at the Association’s meetings, sufficient evidence has been produced to warrant them in recommending the authorities, before coming to any conclusion on the subject of the sewage, and purification of the river, to make experiments on the practicability of such schemes as proceed on the principle of providing that faecal matters must no longer be allowed to enter the common sewers or the river.”

Again, I find in the minutes of a meeting in this section on the 28th December, 1869, in the discussion on Dr. Grey’s paper advocating a system of water carriage, that—“The Section expressed disapproval of that mode, and affirmed to the finding of the Sewage Association on the subject.”

I remind the Section of these resolutions because I consider them real marks of progress, and because they show that we have had the courage to pause, and seek other solutions of the difficulty than that one idea constantly thrust upon us by high engineering authorities, which sounds very like the cry of “Water, water everywhere, but not a drop to drink.”

The present year has been marked by the appearance of two authoritative reports—the “Report of the Rivers’ Pollution Royal Commission,” and the Report of the British Association Committee “On the Treatment and Utilisation of Sewage,” which has appeared as a volume by Professor W. N. Corfield. Of the Report of the Royal Commission, I feel bound to say that it is the most valuable and comprehensive which has yet appeared; the innumerable analyses of water and sewage testify to the completeness of the inquiry; and show that Dr. Frankland has taken up the subject with his usual accuracy and breadth of view. The nature of the enquiry, that of the pollution of rivers, has, however, naturally led the Royal Commissioners to look at our town refuse at the large, and, therefore, in my opinion, the wrong end, and to try to stem the tide of contagion after it has become a river, rather than to deal with the pollution at its source. Irrigation, then, as a necessary consequence, will probably be duly enforced as the compulsory result of a compulsory water-closet.

Of the Report of the British Association Committee, I cannot, however, speak so favourably. This committee

was appointed in 1868, and a short but valuable statistical report from it was read at Exeter in the following year. It was then re-appointed, with a grant of £50 from the Association, and several new members added. The Committee then took the unprecedented course of applying to cities and towns to contribute to their funds in sums proportioned to the number of inhabitants; they thus raised about £1500, of which I understand about £500 have been expended. Several gentlemen representing towns who had thus subscribed indignantly asked, at Liverpool, what had been done with their money; and Prof. Corfield’s book, since published, was their promised solace. The actual report will not appear till the publication of the *Proceedings of the British Association* for 1870, but this work is published under the authority of the Committee, and pretends to be a synopsis of its views. There appears, however, to have been some strong dissension amongst the Committee, for one of their number—in fact, the reporter of the former year—at one of the Liverpool meetings, expressly denied all complicity in the Report of this year. The Committee underwent so severe a handling in two sections where the report was read, that they withdrew it from a third, where it was also to have appeared. My impression certainly is that they would have been more severely handled if Professor Corfield’s work had been then published as the principal result of their labours. This work is a *re-chauffée* of the Report of the Royal Commission, in which the facts of the original are not improved on by the *opinions* of the author.

Corporations and town councils who have subscribed to the British Association Committee will, no doubt, be gratified to learn that they can purchase this interesting volume for 7s. 6d., and read in abstract what has been already published *in-extenso* in a Government blue-book, well illustrated with plans, maps, and engravings, for 5s. Some who have subscribed largely may not object to a balance-sheet in the next edition.

The Committee were charged at Liverpool with a strong prejudice in favour of water carriage and irrigation; and certainly no one can read this work without seeing at once that its purpose is directly to enunciate these views. One remarkable part of this report, however, is that it advocates the use of a separate system of sewers for house sewage, and of settling or filtering the sewage before employment for irrigation. Now the former is an extraordinary admission for sanitary engineers to make; it shows the correctness of our views, and concedes the real point of our demands. We have always been told that a double set of sewers would entirely upset our existing system, and that it never could be carried out. Amongst others, Dr. Anderson, in his report, states it to be impossible. Having now admitted this necessity, the whole question is reversed, and I maintain that the step is in the right direction; and the next consideration (which ought to have been the first) should be to really carefully examine the best methods of dealing with house refuse. This, I maintain, has never been fully, fairly, and systematically done. In neither of the reports now referred to has sufficient justice been done, or sufficient attention been paid, to any system of removal of excreta, other than by water carriage.

Lieurnur’s pneumatic system is not alluded to at all in the Rivers’ Pollution Report, and dismissed in a few words without evidence in the other.

The charcoal method of removal, though brought forward at the British Association at Exeter, and before some of the Committee, is alluded to in neither. Nor is the remarkable deterioration of lead pipes, when attached to water-closets, mentioned, although the evidence has never been contradicted. The ingenious method of distillation of sewage proposed by Mr. Chapman is also unnoticed. Mr. Hoey’s method of saving water in the ordinary closets is not spoken of. Weare’s method of sewage filtration through charcoal and ashes is not referred to. Now these processes may not have come under the notice of the Royal Commission; but I maintain that,

\* Read before the Glasgow Philosophical Society (Sanitary Section), Nov. 9th, 1870.



whatever their value, they ought to have been thoroughly examined by the British Association Committee, who define the term "sewage" as applying "to all refuse of human habitations affecting the health of the country."

In a paper read before you two years ago, I reduced the methods of removal to three—so-called water, air, and earth carriage, and, under these, described how each method should be carried out and tested. I wish now briefly to repeat my views, that you may see how far they were right by these two new lights which have since dawned on us. If water carriage be continued, then it should be conducted by a separate system of cast-iron pipes, which could be easily flushed, and in which gases could not accumulate. If air carriage, then Lieurnur's pneumatic system ought to be thoroughly tested. I showed how economically the faecal matter could be forced from the reservoirs, by a small compressing air-pump, out to a chemical work at any distance, where it could be easily dealt with. If the Lieurnur process gives out any odour, this must be modified by the use of a little powdered charcoal, which could be easily applied by Weare's pepper-box dry-closet lid. If earth carriage be preferred, as I think it eventually will be, then I advised its being re-carbonised until it assumes the form of X charcoal—that is, being re-burned until it represents the charcoal obtained from the excreta. As to ordinary sewage, I gave it as my opinion that no process could ever be devised that would extract from it, chemically, its manurial value. No evidence since has shaken that opinion; and all must agree with Dr. Frankland in his sweeping condemnation of the A B C and other processes of this kind, although I remember our Corporation would not believe in any of us when we tried to prove their absurdity. I stated then, too, that intermittent filtration and irrigation were the only means of purifying sewage. These opinions are fully corroborated by the Rivers' Commission Report. I strongly recommended charcoal for this filtration—by preference, seaweed or X charcoal, and exhibited specimens of sewage thus purified, specimens now again before you in actual *statu quo*. The purification is perfect, but I held out no hopes that more than the suspended matters would be retained. I am induced to allude again more particularly to this filtration, because Messrs. Weare's system has since been introduced to the notice of our authorities. Weare's process is a method of filtration through ashes and charcoal; by the kindness of Mr. Johnson, I am enabled to show you some plans of this method. There can be no doubt of the purification effected; of course, the available nitrogen cannot be separated from the sewage, but the patentees appear to separate sufficient manurial value to make the process pay and produce a saleable manure; and, therefore, even to precede irrigation, it would be a valuable adjunct. The specimens you see before you for the second time are those of thick pure sewage from the bottom of the sewage-well at Worthing, and of Glasgow sewage before and after filtration through seaweed charcoal. The Glasgow sewage contains a good deal of iron, and is not now

offensive; but the other is a pure house-sewage—and any one removing the stopper, and inserting his nose, will believe at once that four years' standing, including some months in the Paris Exhibition, has in no way impaired its character as a choice essence of epidemics; nor has it effected the purity of the filtered water.

I append analyses of the sewage before and after treatment—

	Grains in gallon.			
	Stanford.		Anderson.	
	1.	2.	3.	4.
Solution, organic ..	24.80	24.00	52.80	8.72
„ inorganic ..	72.80	56.60	226.56	124.80
Suspension, organic ..	23.20	19.60	169.76	—
„ inorganic	15.20	14.80		
Total .. ..	136.00	115.00	449.12	133.52
Total organic matter	48.00	43.60		
„ inorganic „	88.00	71.40		
Total .. ..	136.00	115.00		

1. Glasgow, March, 1868; sewer, north side, north-east corner of Jamaica Bridge.
2. Glasgow, March, 1868; sewer, south side, below Jamaica Bridge.
3. Concentrated Worthing sewage; bottom of well.
4. Concentrated Worthing sewage; after filtration of seaweed charcoal.

The Worthing sewage is a severe test, as it contains four or five times the quantity of solid matter found in ordinary sewage; but the purification is perfect to all appearance. I did not find, however, that the charcoal had retained much of the nitrogen.

The phospho-carbon manure made by Weare and Co. sells at 80s. per ton at the works; and the effluent water from the filters is no doubt efficiently oxidised. The process, as a modified method of charcoal filtration, is well worth a full and searching inquiry.

I think all will agree with me that the water-closet system, if connected with a separate system of pipes, and the sewage subjected to intermittent filtration through charcoal, and then used for irrigation where convenient, or run away when it cannot be so used, would be very much safer than at present. With a modified amount of water something might be done with it; but it is questionable whether even then it would pay for the outlay. Both filtration and irrigation must fail if the storm-waters are still allowed to mix with the sewage, as a sudden storm of rain will upset all the arrangements. The Rivers' Pollution Commissioners, however, appear determined to treat the whole refuse of towns with rainfall in the main sewers; and irrigation is, consequently, with them the only remedy, as such a large quantity of water cannot be filtered. Let us, therefore, in view of their certain recommendation to adopt irrigation for Glasgow, look further into this; and here I borrow a table from Mr. W. R. W. Smith.

Sewage in twenty years, per day.	Maximum sewage, per day.		Minimum sewage, per day.		Area.	
	Gallons.	Tons.	Gallons.	Tons.	Grass.	Cereals.
	Gallons.	Tons.	Gallons.	Tons.	Grass.	Cereals.
82,000,000	365,983	..	35,000,000	156,250	10,000 acres.	51,800 acres.
..	..	..	..	..	15 sq. miles.	75 sq. miles.
..	..	..	..	..	16,000 acres.	84,000 acres.
..	..	..	..	..	25 sq. miles.	125 sq. miles.
..	..	..	..	..	23,500 acres.	121,400 acres.
..	..	..	..	..	35 sq. miles.	180 sq. miles.

It is based on Messrs. Bateman and Bazalgette's report, from the experience of Mr. Morton, on the Lodge Farm, at 5400 tons per annum of sewage per acre of grass, and at 1100 tons per annum of sewage per acre of cereals; from which it will be seen that, if cereals are to be largely

cultivated, the Corporation will require in 20 years a small farm of 121,400 acres, or 180 square miles, for cereals, unless they can sell the grass of 35 square miles; either would make a considerable demand on the county of Ayrshire.



We shall await with much interest Dr. Frankland's report of the capability of purification of sewage possessed by the Irvine sand, and also the analyses of the Glasgow sewage. Dr. Anderson's report showed it to possess some remarkable peculiarities, with a general strength two-thirds that of London. Now the difference is due to the increased rainfall; but, as this rainfall has again to be encountered by the sewage *in situ* on the farm, it ought to be double the strength of that of London, to have an equal chance of success, and this even if the temperature were equally warm and the atmosphere equally dry. But it does *not* pay in London, and how can we expect it to do so here.

Some instances are given in the Report of Her Majesty's Commission of Sewage Farms, from which I take the highest return per head per annum; in no case do I find any profits shown. The Lodge Farm experience is said to represent a return of five shillings per head of the population.

In a former paper, I said—"Irrigation, the only method of utilising sewage, puts an amount of money-value on the ground out of all proportion to the return obtained by the ratepayers. There appears no doubt that the farmer will not give one halfpenny per ton for it, delivered free of expense. Where gravitation and open carriers can be employed without pumping, its application is remunerative; but in no case is anything like the full money-value obtained to the ratepayer. The cost of transport, where the chemical value of a product is only one penny per ton, is far the more important item."\* Mr. Hope, of the Lodge Farm, the most prominent advocate of irrigation, has never disproved these assertions.

Professor Corfield says that the British Association Committee will accept no scheme which does not "make it pay." Now, 5400 tons of sewage at one penny per ton for grass land is equal to a top dressing of £22. 10s. per acre, that is, its minimum value. Where is the West of Scotland farmer that would dream of using this manure at its market price?

(To be continued.)

# ON THE BEHAVIOUR OF ROSANILINE TOWARDS AGENTS OF SUBSTITUTION WHEN ATTACHED TO ANIMAL FIBRES.

By PHILIP HOLLAND.

To everyone who has dipped a piece of wool or silk in an aniline colour must the question have suggested itself, How comes it to pass that these substances show so marked an attraction for the "tar colours," cotton not presenting any affinity? Is the peculiarity to be ascribed to a chemical or to a physical cause, or to both?

It is worthy of note that all substances capable, without special chemical treatment, of absorbing and retaining permanently an aniline colour, belong to the animal kingdoms and are, for the most part, highly nitrogenous.

Wool, silk, albumen, horn, and feathers are remarkable evidences of this peculiarity, whilst cellulose, flax, and such like, which are non-nitrogenous, are indifferent.

M. Schützenberger in his "Traité des Matières Colorantes," tome i., inclines to the opinion that, so far as regards the attraction of animal fibres for the tar colours, it is to be ascribed to a chemical cause, and that the organic substance acts as a mordant, forming with the colours an insoluble organic lake. Whether this opinion still holds ground or is negatived by the researches of Walter Crum, Hellot, and others, who pleaded in favour of a mechanical theory, I am unable to say.† Reflecting on the subject, however, led me to make some experi-

ments to ascertain whether or not the three equivalents of mobile hydrogen in rosaniline would submit to agents of substitution as easily when that base is attached to a fibre as they do when it is free. An answer in the negative would lend additional support to the chemical theory to some extent.

A clear solution of acetate of rosaniline was prepared, and with it specimens of silk and merino were dyed; they were removed before they became so far saturated with colour as to be incapable of absorbing more, then well washed and dried.

A piece of silk about an inch square was put in a tube, together with 2 c.c. of iodide of ethyl. The closed tube was then heated at 100° C. for about two hours, and opened when cold. The silk, which was quite broken up, was changed in colour to a brown-violet. A little forethought would have prevented this unfortunate climax to the experiment. The iodide was not dry, which accounts for the formation of a little hydriodic acid, and consequent destruction of the tissue. The experiment was repeated with re-distilled and dry iodide diluted with six parts by measure of dry benzol. The mixture was enclosed in a small bulb, which was afterwards broken in the sealed tube.

This device prevented the presence of free iodine caused by decomposition of the vapour of the iodide when closing the tube. The latter was then heated at 110° for one hour. The silk, on removal, was found to be dyed a deep violet, and resisted attempts to tear it.

A larger specimen was prepared in a similar manner, using the iodide still further diluted. The brilliancy of colour is equal, I believe, to that of silk dyed in the usual way, and may be expected to resist washing even better, since iodide of tri-ethyl rosaniline, a somewhat insoluble salt, is, in this experiment, precipitated within the cellular structure of the silk.

My success led me to attempt other substitutions. The next derivative of rosaniline which presented itself was the blue. As, however, the "phenylation" of rosaniline by means of aniline only proceeds at 180° C. or thereabouts, a temperature sufficiently high to destroy silk, the experiment was not made.

Fortunately, I recollected the action of aldehyde on acid solutions of magenta, whereby the red changes to a blue-violet. A high temperature is, in this case, unnecessary, a feature exactly suited to the requirements. A portion of crude aldehyde was put into a flask and acidified with H<sub>2</sub>SO<sub>4</sub>. A piece of the rose-dyed silk was immersed in the liquid. At the end of a few seconds it changed colour, becoming more and more violet as the fluid was agitated. At the end of half an hour the action was complete; the specimen was then washed to remove acid, and dried. The colour is a reddish-violet, very brilliant by day, but only dull by artificial light. This violet is said to be fugitive. It may, perhaps, be less so when fixed as here described. More easy of execution than the former one, this experiment is a further example of the fact that the replaceable hydrogen in rosaniline is just as mobile when that base is attached to a fibre as it is when the base is at liberty. The last experiment may be expeditiously made as follows. Into a long-necked flask is placed some bichromate of potassium together with more than sufficient water to dissolve it when cold (say, six parts by weight); sulphuric acid is then added equal in weight to the bichromate, and the mixture well cooled under a stream of water; the alcohol (methylated) rather more than the weight of the bichromate is added in small portions, shaking the flask vigorously under the stream the while. When all the alcohol is added and the flask ceases to communicate heat to the hand the operation is finished. This solution is rich in aldehyde, the heat generated being insufficient to provoke a more complete oxidation, and is quite fitted to produce on the rose-dyed silk the change above described.

Having proceeded thus far in producing substituted colour on silk, it seemed desirable to attempt the produc-

\* See CHEMICAL NEWS, vol. xix., p. 255.

† Persoz, "Traité de l'Impression des Tissus," tome ii., p. 128.



tion of a more complex body than aldehyde violet, viz., the green. Unfortunately, the green is, I believe, only formed under conditions wherein silk would be destroyed. A single experiment however, was made with this view.

M. Lucius patented a process some time ago for the preparation of the green in which he takes advantage of the reducing property of  $H_2S$ .

Thinking I might succeed in producing the green by heating the rose-dyed silk with solution of  $H_2S$  and excess of aldehyde, the experiment was made. The silk, however, was destroyed; the fluid had a green tinge. I hope to return to this matter.

All the above experiments were made with wool, and gave similar results.

Aniline red on cotton, fixed with albumen, is susceptible of conversion into aldehyde violet. Theoretical considerations would scarcely lead one to expect a successful issue in this instance, but would rather imply that insoluble albumen, locking up the colour in the fibre of the cloth, would present a barrier to some extent impassable to cold aqueous solutions. Such does not appear to be the case.

When rose-dyed silk or wool is dipped in a strong solution of aldehyde the change of colour is instantaneous and partakes more of a blue shade; it is very fast to boiling soap. Such a method of using aldehyde violet may be found advantageous in practice and possibly replace other violets more expensive to manufacture.

Chorley, Lancashire.

## ON FERMENTATION.\*

By Professor A. W. WILLIAMSON, F.R.S.

(Continued from p. 269).

### LECTURE II.

OUR last lecture ended at a point at which we had come to recognise a difficulty, which we did not, to any appreciable extent, succeed in solving. By considering in succession a certain small number of processes in which substances induced chemical changes in others which were in contact with them, we classified them, beginning with some very complex cases—cases in which substances, of formulæ so long that, even if I ventured to give you chemical formulæ at all, I should hesitate to give you their formulæ—took part in the decomposition, and gave rise to products themselves having formulæ of no small complication. From those we passed to the consideration of some bodies less complex in their structure, and undergoing changes very much like those which we at first considered, but having this remarkable peculiarity that, in these somewhat simpler cases, the changes were effected not only by organic bodies comparable to ferments, but also, in certain instances, by simple mineral bodies, such as the acids. In this intermediate class we found that the same effects are produced, sometimes by diastase, or such like bodies, and sometimes by sulphuric acid. Then we came to some still more simple cases of decomposition, produced solely by bodies of such simplicity that we chemists have got a tolerably definite idea of them. I gave two cases which I believe I may say are pretty well understood. The resemblance between the different terms of that long series served, as I think it will be admitted by those who followed the chain of reasoning, as an argument in favour of there being some great resemblance in the process which takes place in these changes in the successive terms of the series; and I propose, before we proceed further in the study of these wonderful decompositions, to analyse somewhat the nature of these changes in the simple cases which we last considered, in order that we may get, if possible, something like a master-key—a very simply-formed piece of iron—which will open a variety of locks. The two cases which I allude to were, first, the formation of ether and water from alcohol by the action of oil of vitriol; and,

secondly, the ordinary process of making oil of vitriol in the so-called lead chambers; and I think it will be admitted, even from the very brief and imperfect statement which I was able to make, that we have evidence of the fact that the active substances do return, after they have been doing one bit of that work, from the point from which they started before doing it. I gave a couple of illustrations of that fact. Sulphuric acid is converted, while making alcohol into ether and water, into a substance called sulphy-vinic acid, which differs from it in a good many properties, and then it comes back again to sulphuric acid. Just so with nitric oxide, in the process of making oil of vitriol; it first takes up oxygen and assumes the form of those red fumes, then hands that oxygen over to the sulphurous acid which is in contact with it, thus coming back again to the state of nitric oxide from which it had started. Hence the term which I have suggested for this process is cyclical, to denote the fact which I consider essential, the leading fact, that it is a cycle, the idea of which implies that the road by which it returns is not the same by which it goes, and I want that idea to be suggested by the word. In the case of etherification, I wish I could lawfully use formulæ on the blackboard, but it would not do, for I am sure that the greater number of my audience will agree with me that it would be a liberty which I ought not to take; but chemists are in the habit of denoting, by the aid of formulæ, particulars which require to be fully explained. I mention that because, excluding that ordinary process, the particulars of my argument must, of course, be omitted, inasmuch as I do not use the language by which alone those particulars can be conveyed. When the sulphuric acid acts upon alcohol, and transforms it, by a succession of these cyclical processes, into ether and water, the general kind of process is this:—A little particle of the acid—because each one acts like the rest, and we had better consider one as a sample of the rest—first takes something from a contiguous particle of alcohol, and then it hands over this something to another particle of alcohol. That which the acid takes in the first instance is called, in our ordinary language, ethyl. It is a group consisting of carbon and hydrogen, very much like hydrogen gas—it is a group of those elements, and behaves in a manner closely analogous to hydrogen itself. The acid, in doing that particular work which we have to consider, first takes a particle of this ethyl from one particle of alcohol, and whilst it does so, it gives to the alcohol something in exchange; that something is hydrogen. And by doing this, the sulphuric acid which has taken up this ethyl is converted into sulphy-vinic acid; it has gone half round the circle, in fact. The remainder of its journey consists in reversing, in another way, with another particle of alcohol, that very same kind of interchange which it had undergone in the first instance, that is, it gives up again this little portion of ethyl which it had taken, and resumes hydrogen in place of it. Just as that is the general process when sulphuric acid acts upon alcohol, forming it into ether and water, so in the other process, which I just now reminded you of, there is a similar action, only there is this difference—of course, I speak within those narrow limitations which are imposed upon us by our very imperfect knowledge of even these best-known processes—but, as far as we know, the nitric oxide merely takes up oxygen, but gives up nothing in exchange. Those red fumes which you saw were really nitric oxide *plus* oxygen, not nitric oxide in which oxygen had replaced something else, and that was a difference between the process in that case, and in the one to which I just now referred. Then, again, it simply gives up that oxygen to the particle of sulphurous acid.

The illustrious Liebig, to whom we owe, in this order of phenomena as in every other order which he has touched, some of the most valuable ideas which have guided our researches, suggested many years ago, for the explanation of the phenomena of fermentation, a theory which certainly has rendered very great service, and not the less so from the fact that it has been replaced

\* The Cantor Lectures. Delivered before the Society of Arts.



by one more perfect. In building a house, it is certainly no proof that a scaffolding is unnecessary that in the final structure the scaffolding is not maintained; and so in the progress of our science, as in every other science, each part of the work must be judged from its usefulness in aiding the carrying on of the building, even though the particular substance which was placed there at the time does not finally form part of the structure itself. Liebig's explanation really is classic, and well worthy of a few minutes' consideration. He classed together a considerable number of cases of chemical action which bore, at least upon their surface, a considerable resemblance to one another, and he saw in them something in common, and by this one resemblance which they had he classed them, considering it to be their essential characteristic feature. For example, there is a substance which is made, by a process of oxidation of a compound something like lime. It is called baryc peroxide. Thenard had found that the oxygen which is here taken up by the baryta can, by a particular process, be passed over to water, so that, in fact, Thenard, from his oxide of baryta, made by a process which I will repeat on a small scale, some oxidised water or peroxide of hydrogen, as it is commonly called. Here is some of the peroxide suspended in water, and by adding an acid hydrogen salt, the hydric nitrate, in small quantities (for if I add it in too large quantities, I should destroy the peroxide, which is a very tender substance, and requires to be treated tenderly), I should gradually transfer the oxygen from the baryta, with which it was at first combined, to the water which is here present. This oxidised water, or peroxide of hydrogen, gives up this oxygen which it has just taken up very easily indeed—in fact, the difficulty is to prevent it doing so. Amongst processes of that kind, I will show you one simple one. I will pour into the water in this large beaker glass some of the solution which I have just prepared, and then add to it a few drops of this red liquid, which is a solution containing chromic acid combined with potash. You see, no doubt, that although I have only added half-a-dozen drops, there is evidence of a chemical change, and the deep blue colour which is formed by the contact of the two liquids is due to the formation of a new compound. The chromic acid, which has a red colour, takes up oxygen from that peroxide of hydrogen, forming a blue compound. I have purposely chosen this particular instance, because the process is a slow one, and we have time to see its intermediate changes. I will leave the glass here, and in a few minutes you will see the blue colour will have disappeared, and in place of it we shall have a dirty green colour, hardly visible. Whilst that change takes place, if we were to take means to examine carefully what was going on, we should find that oxygen gas passed off, and if we examined the green substance present at the end of the process, and compared it to this original red chromic acid, we should find that it consists of chromic acid *minus* oxygen. The peroxide takes away oxygen from this chromic acid, and yet the chromic acid has got hold of its oxygen pretty firmly; it requires a considerable amount of energy to tear away even that part which is torn away by the process. But at the same time the oxygenated water is losing part of its oxygen. The deoxidation of the peroxide induces the chromic acid to give up some of its oxygen; the one body induces in the other a change similar to that which itself is undergoing. The peroxide of hydrogen is losing oxygen, and it makes the chromic acid also lose oxygen. To state the process in general terms, I may well use the expression of Liebig, and call it contagious action. There are many other cases of similar processes. Here is a bit of rotten wood; if I were to moisten it and put it into a convenient flask, leaving room for a quantity of air, closing the mouth of the flask with a good cork, and leaving it for a day or two, also putting with the air a little hydrogen gas, which, you know probably, is capable of combining with oxygen, I should, on examining the mixture of air and hydrogen after it had been in contact some time with this rotten

wood, find that the hydrogen had been removed from the air, and at the same time the oxygen of the air which had been mixed with it had disappeared. Now, this wood is actually undergoing a process of combustion—it is actually absorbing oxygen, or being burnt, very slowly indeed, but still at a rate which is not unimportant, if you want it to last for any length of time. De Saussure, who noticed this, attributed the oxidation of the hydrogen gas to the fact that the wood is itself undergoing oxidation. I will take another case of the same kind. I will put into a little flask some of that peroxide of hydrogen, and will show you another decomposition of it, which is rather more convenient in one respect than the one I first took, as it will show us something more of the process. Into this little flask I put some of the same oxidised baryta which I used just now, and I will fit up the flask in such a manner that the gas, which will come off in a tolerably large quantity, can be collected for examination. I will then put in contact with it a substance called silver oxide, first driving out of the flask all the air which it at present contains. Having driven out the air, I put in a few drops of the nitrate which I employed in the first instance, and then I will put in a solution of silver oxide, which is, in some respects, a good deal like this chromic acid, at all events in one important respect, for it has oxygen, which it can give up under sufficiently strong pressure. You now see there is a great deal of effervescence going on, and the gas which is coming off from the little flask is rising into this jar, where we shall very easily be able to ascertain whether it is oxygen by the ordinary test. I should have been glad, if it had been convenient to do so, to give you one other instance in which a remarkable fact was discovered by Professor Brodie, viz., a case of an action of this kind, where the oxygen taken from the peroxide is in quantity exactly equal to the quantity of oxygen from the other body. Whilst that gas is collecting, I must enter shortly upon a theoretical question, apologising for doing so, not that I am ashamed of it, for it is one of the most important theories we possess, but on account of the brevity with which I am compelled to treat it. Oxygen, in the free state, is admitted by chemists to consist of two little atoms linked together. In each of the compounds which I used there was one little atom of the kind. One atom leaves each of them, and when I get free oxygen, I affirm that there has been a process of combination, that the oxygen from the one substance actually combined chemically with the oxygen from the other. This is a theoretical result which has been, in great part, established by Sir Benjamin Brodie, with the help of materials from various sources. What I mentioned in the other case holds good equally in regard to chromic acid and the other cases in which there was apparently no definite proportion of the kind. There is an actual chemical combination between the oxygen of one substance and that of the other; it is not merely that the one substance is compelled to decompose because the other is decomposing; there is between the one substance and the other an interchange, so that a constituent from each one combines with a constituent from the other. To do justice to the importance of this fact I should need to describe a great number of chemical reactions, which at present would be impracticable, but you may take my word for it, that the kind of process which I have described is now known to be one of the commonest in chemistry. The other day, when I mixed two of the commonest substances, there were interchanges between the constituents by a process perfectly analogous to that which takes place here. Here it happens, by an exceptional circumstance, that the element which from the one body combines with the element of the other is of a like kind, whereas, as a rule, you find that unlike elements unite together in these processes. Thus it is that the anomaly which Liebig noticed ceases to be an anomaly, and is brought back to a case of common regular chemical action by the aid of that theory to which I have just alluded.

(To be continued).



## SCIENTIFIC NOTES FROM AMERICA.

By PROFESSOR LEEDS.

THE chemists engaged in the manufacture of phosphates for agricultural purposes will be interested in the extensive use which is being made at the present time of large beds of phosphatic material located upon the Ashley River in South Carolina. It occurs in the form of nodules or pebbles, which are enclosed in a layer of bluish mud, the whole having an average thickness of fifteen inches, and extending in a nearly horizontal layer over an area of many square miles. Although it has long been known, and its very abundant fossils were referred by the geologists of the State Survey to the post-pliocene formation, yet the gravest mistake was made by the farmers of the neighbourhood regarding the chemical nature of these phosphatic nodules. They were regarded as siliceous limestones, and the numerous failures which attended the employment of the product arising from burning them in kilns were attributed to the supposed excess of silex contained in them. The pebbles constitute about 63 per cent of the bed, and the yield of phosphatic material to the acre is about 1200 tons.

The first bar of tin ever made in the United States was recently presented to the Society of Pioneers in California. It contains, by assay, 97.09 per cent metallic tin. On one side is engraved the inscription—"First bar of tin ever produced in the United States from the native ore, taken from the San Jacinto Tin Mine, San Bernado County, California. Presented to the Society of California Engineers, by O. P. Sutton, April, 1870."

A trial was recently made of the so-called United States Chemical Fire Engine, upon a vacant lot situated in the suburbs of New York. Two two-storied buildings were erected and filled with tar barrels. Both of them were drenched with gasoline, in order that the flames might rage with great fury. One of the buildings, on ignition, was played upon with a solution of sodic sulphite in numerous small streams, the other with ordinary water. The trial was not satisfactory, because the framework of the buildings was so slight, that both buildings gave way shortly after the fire commenced, and were converted into a heap of ruins. It is claimed by the inventors of these fire engines, that the sodic sulphite is decomposed in contact with burning surfaces, and that the sulphurous acid gas which is disengaged, while efficacious in extinguishing of flames, is less injurious to the firemen than the carbonic acid gas employed in a rival invention.

A great blow has recently been given to the long cherished hopes of many of our chemists and naturalists. It was proposed that four small public parks, known as the Penn Squares, which are located at the intersection of Broad and Market Streets, the two principal thoroughfares of Philadelphia, should be given to the Academy of Natural Sciences, the American Philosophical Society, the Franklin Institute, and the Academy of Fine Arts. All of these institutions have suffered greatly of late years for want of room and suitable accommodations for their collections of specimens, books, models, and painting. But the people in a general election—an impression having been made that public property to a large amount was about to be given away to private parties for private ends—decided by an overwhelming majority in the negative.

At a recent meeting of the American Philosophical Society it was stated by Dr. Genth that, according to Del Rio, an alloy of gold and rhodium is found in Mexico, which contains from 34 to 43 per cent of the latter metal. This discovery has never been confirmed, and there is perhaps no mineralogist living who has ever seen it. Some experiments which he has lately made with residues from San Domingo gold leave very little doubt as to the existence of this very interesting substance. Professor Gabb sent a lot of gold from San Domingo to Dr. Horn, who dissolved out the gold by *aqua regia*, and placed the remainder in Dr. Genth's hands for examina-

tion. He found that it consisted of iridosmine, of a dull yellowish substance in microscopic rounded and angular grains, and a silicate which, under the microscope, appeared to be topaz. One of the yellowish grains acquired metallic lustre when flattened out in an agate mortar. It was almost insoluble in *aqua regia*, but by treating it for several days with a large excess of this solvent, it was finally brought into solution. A trace of ammoniac chloride was added, and the whole evaporated to dryness and sufficiently heated to reduce the gold. Mixed with this were microscopic reddish crystals, which were dissolved in boiling water, filtered, the filtrate evaporated to dryness, and the residue slightly heated, by which it assumed a reddish brown colour. On being fused with potassic bisulphate it gave a slightly rose-coloured mass, soluble in water, and precipitated yellow by ammonia. From these reactions there seems to be no doubt that the yellowish grains are rhodium gold.

At a subsequent meeting, Dr. Genth exhibited photographs of a new meteoric iron, weighing about twenty pounds, which was found on a small mount in Rockingham Co., N. Carolina. The iron is coated with a crust of hydrated sesquioxide of iron. A polished portion of it, after etching with dilute nitric acid, developed the Widmannstædtean figures, and showed a very remarkable structure of the iron. It is composed of three different kinds of iron—one portion of it is quite homogeneous, and has a very fine granular structure; if, however, the light is reflected in different directions it shows a peculiar glistening, and, very faintly, lines intersecting at angles of about 60° and 120°; this same iron runs into bands of not over 0.5 m.m. diameter, which, at another portion of the iron, intersect at angles of about 60°. The space between the bands is filled with an iron presenting a reticulated structure. Disseminated through the iron are crystals of rhabdite, but few only show a regular arrangement. A preliminary analysis gave—

	Per cent.
Iron .....	90.41
Nickel (cobalt) .....	8.74
Copper .....	0.11
Iron .....	0.27
Nickel (cobalt) .....	0.33
Phosphorus .....	0.14
Traces of a quartz mineral.	

Dr. Genth also exhibited specimens of native iron and native lead from the bed-rock of gold-placers, at Camp Creek, Montana Territory.

The native iron is found in small angular fragments, but slightly coated with rust; the largest which he has seen is about 0.5 inch in length. Etching with dilute nitric acid does not develop any Widmannstædtean figures, but a finely granular structure. Nickel and cobalt are not present. Associated with the iron is native lead, in irregularly shaped rounded and flattened pieces, from the size of a pin's head to about 0.5 inch in diameter.

Philadelphia, Nov. 2, 1870.

## PROCEEDINGS OF SOCIETIES.

## MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, November 29th, 1870.

R. ANGUS SMITH, Ph.D., F.R.S., Vice-President, in the Chair.

"The Tails of Comets, the Solar Corona, and the Aurora considered as Electric Phenomena," by Professor OSBORNE REYNOLDS, M.A.



Although the tails of comets are usually assumed to be material appendages which accompany these bodies in their flight through the heavens—and the appearance they present certainly warrants such an assumption—yet this is not the only way in which these tails may be accounted for. They may be simply an effect produced by the comet on the material through which it is passing; an effect analogous to that which we sometimes see produced by a very small insect on the surface of still water. We see a dark spot, and on looking closer we find a small fly or moth flapping its wings and creating a disturbance which was visible before the insect which produces it.

There is nothing else that we can conceive their tails to be, so that they must be one or other of these two things; either—

(1) Material appendages of the nucleus, whether the material be limited to the illuminated tail or surround the comet on all sides.

(2) Matter which exists independently of the comet, and on which the comet exerts such a physical influence as to render it visible.

Respecting the composition of these bodies, Sir John Herschel says:—"There is, beyond question, some profound secret and mystery of nature concerned in the phenomenon of their tails. Perhaps it is not too much to hope that future observation, borrowing every aid from rational speculation, grounded on the progress of physical science generally (especially those branches of it which relate to the ætherial or imponderable elements) may ere long enable us to penetrate this mystery, and to declare, whether it is matter in the ordinary acceptation of the term that is projected from their heads with such extravagant velocities, and if not impelled at least directed in its course by reference to the sun as a point of avoidance. In no respect is the question as to the materiality of the tail more forcibly pressed on us for consideration than in that of the enormous sweep which it makes round the sun in perihelio, in the manner of a straight and rigid rod, in defiance of the law of gravitation, nay, even of the received laws of motion, extending (as we have seen in the comets of 1680 and 1843) from near the sun's surface to the earth's orbit, yet whirled round unbroken; in the latter case through an angle of  $180^\circ$  in a little more than two hours. It seems utterly incredible that in such a case it is one and the same material object which is thus brandished. If there could be conceived such a thing as a *negative shadow*, a momentary impression made upon the luminiferous æther behind the comet, this would represent in some degree the conception such a phenomenon irresistibly calls up. But this is not all. Even such an extraordinary excitement of the æther, conceive it as we will, will afford no account of the projection of lateral streamers, of the effusion of light from the nucleus of the comet towards the sun; and its subsequent rejection of the irregular and capricious mode in which that effusion has been seen to take place, none of the clear indications of alternate evaporation and condensation going on in the immense regions of space occupied by the tail and coma—none, in short, of innumerable other facts which link themselves with almost equally irresistible cogency to our ordinary notions of matter and force."

There can be no doubt that if these tails are matter moving with the comet, this matter must be endowed with properties such as we not only have no experience of, but of which we can form no conception. This alone would seem a sufficient reason for rejecting the first hypothesis. Moreover, on the second hypothesis there is no difficulty in the immense velocity with which these tails are projected from the head or whirled round when the comet is in perihelio. For to take the "negative shadow" as an illustration, here we should have a velocity of projection equal to that of light, and the only effect of the whirling would be a slight lagging in the extremity of the tail, causing curvature similar to that which actually exists. And whatever the action may be, if its velocity of emission or transmisson be sufficiently great, this effect will be the

same; but whether this hypothesis is to be rejected because involving assumptions beyond conception or contrary to experience, must depend on the answers to the following question—Do we know, or can we conceive, any physical state into which any substance which can be conceived to occupy the space traversed by comets could possibly be brought so as to make it present the appearance exhibited by comets?

Now, I think the answer must be in the affirmative, and that we may leave out the terms conceive and conceivable. For electricity is a well-known state, and gases are well known substances; and when electricity, under certain conditions, as in Dr. Geissler's tubes, is made to traverse exceedingly rare gas, the appearance produced is similar to that of the comets' tails; the rarer this gas is, the more susceptible is it of such a state, and, so far as we know, there is no limit to the extent of gas that may be so illuminated. Hence we may suppose the exciting cause to be electricity, and the material on which it acts and which fills space to have the same properties as those possessed by gas. What is more, we can conceive the sun to be in such a condition as to produce that influence on this electricity which should cause the tail to occupy the direction it does. For such an electric discharge will be powerfully repelled by any body charged with similar electricity in its neighbourhood.

The electricity would be discharged by the comets on account of some influence which the sun may have on them, such an influence being well within the limits of our conception.

The appearances of the comet in detail, such as the emission of jets of light towards the sun and the form of the illuminated envelope, are all such as would necessarily accompany such an electrical discharge.

In fact, if the possibility of such a discharge is admitted, I believe it will explain all the phenomena of comets. As to the possibility, or even the probability, of such a discharge, I think it may be established on very good grounds.

The tails of comets may or may not be one with their heads; but whichever is the case, it is certain that the difference in the appearance of comets and of planets indicates some essential difference either in the materials of which these bodies are respectively composed, or else in the conditions under which their materials exist. Now from the motion of comets we know that their heads follow the same laws of motion and gravitation as all other matter, and therefore we have good evidence, so far as it goes, that comets and planets are similarly constituted as regards materials. And since the appearance of a comet changes very much as it passes round the sun, any assumptions with regard to the material of comets in order to account for their difference from planets would not account for the variety of appearance the same comet presents at different times. On the other hand, the conditions of comets and planets must necessarily be very different, from the extreme difference in the shapes of the orbits they describe. Each planet remains nearly at a constant distance from the sun (whatever that distance may be), so that the heat or any physical effect the sun may have upon it will also be constant; on the comets its action must change rapidly from time to time, particularly when the comet is in certain parts of its orbit. Hence we may say that the temperature and general physical condition of planets is nearly constant, and that of comets for the most part continually varying.

There is, too, a very remarkable connection between the appearance of the comet and the rate at which the sun's action on it changes. Herschel says:—"Sometimes they first make their appearance as faint and slow moving objects, with little or no tail, but by degrees accelerate, enlarge, and throw out from them this appendage, which increases in length and brightness till (as always happens in such cases) they approach the sun and are lost in his beams. After a time they again emerge on the other side, receding from the sun with a



velocity at first rapid, but gradually decaying. It is, for the most part, after thus passing the sun that they shine forth in all their splendour, and their tails acquire their greatest length and development; thus indicating plainly the sun's rays as the exciting cause of that extraordinary emanation. As they continue to recede from the sun their motion diminishes and their tail dies away, or is absorbed into the head, which itself grows continually feebler, and is at length altogether lost sight of."

Here, although unconsciously, Herschel has connected the increase of brightness with the increase of speed with which comets approach the sun, and the diminution in brightness, with the diminution of the velocity with which they leave the sun. And although from Herschel's remark just quoted it might be inferred that proximity to the sun is the cause of the increase of brightness, this is proved not to be the case, for (as in the case of Halley's comet) when near its perihelion the tail always dies away, and the comet shrinks. Thus when the comet is nearest to the sun there is no development of tail, which shows clearly that it is not the intensity of the sun's rays but the change in their intensity that is the exciting cause of these extraordinary appearances. So that there is no reason to suppose that a planet composed of the same material as a comet, no matter how close to the sun, would show a vestige of tail or other cometic appearance.

It is, then, to this change in position that we must attribute those peculiar appearances which belong to comets.

Now, is not electricity the very effect which would naturally result from such a state of change and variation in condition?

A. De la Rive remarks, "Electricity is one of the most frequent forms which the forces of nature assume in their transformations. It certainly often accompanies a change in temperature. There is every indication that it is so in our atmosphere, for the times when its intensity is a maximum are just after sunrise and just after sunset, both winter and summer.

From these reasons it seems to me not only possible but probable that these strange visitors to our system are clothed in electrical garments with which the regular inhabitants are unacquainted.

The electricity must, after all, depend on the composition of the comet, for known substances do not all show the same electrical properties. Hence, by assuming comets to be composed of various materials, we have a source to attribute the different appearances presented by the different individuals. To the same source we may attribute the irregularity in the direction of their tails and the lateral streamers they occasionally send out.

Secondly, I think this electrical hypothesis is supported by the, to me, seeming analogy between comets, the corona, and the aurora; an analogy which suggests that they must all be due to the same cause. They may be all described as streams of light, or streamers, having their starting point more or less undefined, and traversing spaces of such extent and with such velocities as entirely to preclude the possibility of their being material in any sense of that word with which we are acquainted.

The aurora has long been considered as an electric phenomenon, and recently the same effect has been produced by the discharge of electricity of very great intensity through a very rare gas, there being no limit to the space which it will thus traverse. This being so, why should not the tails of comets and the corona also be electric phenomena? Their appearance and behaviour correspond exactly with those of the aurora, and there is surely nothing very difficult in imagining the sun which is the source of so much heat being also the source of some electricity. Neither will there appear anything wonderful in the electricity of comets when we consider that of the earth. We must not look on our inability to explain the cause of such an electric discharge as fatal to its existence, for we cannot any more explain the existence of the electricity which causes the aurora. If we cannot explain

from whence these electricities come, we can at least show that the conditions which are most favourable to the development of the aurora exist in much greater force on the comets than they do on the earth. The greatest development of the aurora borealis takes place at the equinoxes. There is a cessation in summer, and another in winter. Now, the equinoxes are the times when the action of the sun on our northern hemisphere is changing most rapidly. Hence the condition favourable for the aurora is changed in the action of the sun. The same thing is pointed out by the diurnal variation in the electricity of the atmosphere. Now, as has been already shown, the change in temperature on the comets is incomparably greater than it is on the earth, and its variation corresponds with the variation in the splendour of the comet.

Angström has also shown that the light from the aurora, the corona, and the zodiacal light, are all of the same character, or all give the same bright lines when viewed through the spectroscope, and that these lines correspond to the light from no known substance. This indicates that whatever this light may be, the incandescent material is the same in all cases; or may we not assume that it is the medium which fills space that is illuminated by the electric discharges? This would be supported by the fact that the light from the heads of two small comets indicated carbon, whereas that from the tails only gave a faint continuous spectrum. For an electric discharge would first illuminate the atmosphere of the comet, or even carry some of the solid material off in a state of vapour, and then pass off to the surrounding medium. Thus, while the spectrum from the head would be that of cometary matter, the tail would be due to the incandescent ether.

I would here suggest that gas, when rendered incandescent by electricity, may reflect light—it will certainly cast a shadow from the electric light—and if this be the case, part of the light from comets' tails may after all be reflected sunlight.

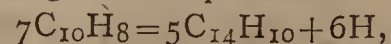
At any rate, it is certain that the appearance of streamers, the rapidity of change and emission, the perfect transparency and the wave-like fluctuations which belong to these phenomena, are all exhibited by the electric brush; in fact, the electric brush will explain all the appearances, which have defied all attempts at explanation on a material hypothesis.

I have only to add that the main assumption involved in the electric theory is, that space is occupied by matter having similar electrical properties to those of these; and I would ask, is it not more rational to make such an assumption than it is to attribute unknown and inconceivable properties to cometary matter?

Theories even, if founded only on rational speculation, often, I believe, prove very useful, inasmuch as they afford observers a definite purpose in their observations—something to look for, something to establish or to refute; and I publish these speculations of mine at this particular moment in the hope that they may perchance serve such a purpose.

"On Iso-di-naphthyl," by WATSON SMITH, F.C.S. Communicated by Professor ROSCOE, F.R.S.

About the commencement of the month of March, 1870, when endeavouring, on the suggestion of Mr. John Barrow, in whose laboratory I was then engaged, to obtain anthracene by the action of a red heat upon naphthalene, the vapour of this body being passed through a red-hot tube, I found that, instead of the anticipated result occurring, according to the equation—



a body was obtained which had a *melting-point* and also a *boiling-point* pretty nearly agreeing with those of anthracene, but almost all its other properties were dissimilar to those characterising that body.

This substance I found to fuse at from 200° to 204° C., its boiling-point lying over that of mercury considerably, and also over that of anthracene as nearly as I could judge. It is difficultly soluble in alcohol and ether, more



soluble in carbon tetrachloride and benzol, freely soluble, even in the cold, in carbonic disulphide and oil of turpentine.

From all the above solutions except that of the turpentine it crystallises in beautiful silky rhomboidal plates, which, on drying, interlamine, and possess a delicate light yellowish green colour and silky lustre. From the turpentine it crystallises in beautiful white lance-shaped crystals congregating in tufts. Its subliming-point lies considerably below its boiling-point, indeed not far above its melting-point.

It may be obtained perfectly white by carefully subliming the re-crystallised substance at as low a temperature as possible. If the semi-purified body be re-crystallised from any of the above-named solvents, the mother liquors on filtering are found to have acquired a beautiful blue fluorescence, but the perfectly pure substance no longer yields a fluorescent solution.

A mixture of two parts of potassium bichromate and sulphuric acid, cause energetic oxidation of this substance, but no colouring matter is obtained by treating the product of oxidation so obtained, by Perkin's method for obtaining alizarin from anthrachinon.

Cold sulphuric acid is without action upon it. Warm sulphuric acid dissolves it, if pure, with a slight purplish colour. If containing any of the yellow substance which always contaminates the crude body, the warm acid assumes a blue colour, which, on further warming, becomes green and then brown.

Nitric acid oxidises it, with liberation of nitrous fumes.

Chlorine passed over it in the cold does not affect it, and apparently not even on slightly warming.

I find that it is impossible to distil naphthalin to dryness in any quantity, without this body being formed in minute quantity. If an appreciable quantity be not obtained on first distillation, it will be by transferring back the distillate to the retort and again distilling to dryness; a minute quantity of high boiling residue will then be obtained, raising the temperature towards 300° C.

A quantity of the pure substance, submitted to organic analysis, furnished the following numbers:—

				Grms.
I.	0.1240	gram. of substance gave	0.4307	CO <sub>2</sub>
			and 0.0624	H <sub>2</sub> O.
II.	0.1237	„ „	0.4284	CO <sub>2</sub>
			0.0626	H <sub>2</sub> O.
				Calculated for
		I.	II.	$\left. \begin{matrix} C_{10}H_7 \\ C_{10}H_7 \end{matrix} \right\}$
Carbon	.. ..	94.72	94.46	94.49
Hydrogen	.. ..	5.59	5.62	5.51
		<hr/>	<hr/>	<hr/>
		100.31	100.08	100.00

The hydrogen evolved in the process was collected and measured, and the following calculation made:—

Weight of naphthalin converted 26.30 grms. (nearly).

Volume of hydrogen at 0° C. .. .. = 2359.7 c.c.  
= 0.2107 gram. H.

$$\frac{256}{2C_{10}H_8} = \frac{C_{10}H_7}{C_{10}H_7} \left\{ \frac{2}{+ H_2} \right\} \therefore 26.3 \text{ grms. lose } 0.2055 \text{ gram. H.}$$

Hydrogen actually liberated .. .. = 0.2107 gram.

Hydrogen calculated as above .. .. = 0.2055 gram.

For the formula  $7C_{10}H_8 = 5C_{14}H_{10} + 6H = 0.1861$  gram. of H. must be liberated.

From these considerations, and seeing that the properties of the body considerably differ from those of di-naphthyl as obtained by Dr. F. Lossen,\* I propose to regard this body as an isomer, and propose to name it accordingly *Iso-di-naphthyl*.

## NOTICES OF BOOKS.

*A Cyclopædia of Quantitative Chemical Analysis.* By FRANK H. STORER, A.M., Professor of General and Analytical Chemistry in the Massachusetts Institute of Technology. Part I. Boston and Cambridge (U.S.): Sever, Francis, and Co. London: E. and F. N. Spon. 1870.

THIS work will be welcomed by all who take an interest in chemistry as a step in the right direction. In compiling the book, the object of the author (well-known to the scientific public as an accomplished *savant* and an excellent editor of several valuable works) has been not only to provide the student and working chemist with a comprehensive dictionary of quantitative processes, but to call the attention of the chemical fraternity to the question of the possibility of presenting this branch of chemistry in a more serviceable and manageable form than has been customary hitherto. The work, indeed, in its first edition is to be considered as an experiment only. The substances are classified in alphabetical order, and every process is referred to the fundamental fact or principle upon which it depends. As instances of the method adopted by the author we give the following extracts:—

ACETIC ACID.—*Principle I.* Power of neutralising alkaline solutions. *Applications:* Estimation of free acetic acid in vinegar, pyroligneous acid, and other aqueous solutions (Method A); Determination of acetic acid in certain acetates from which caustic soda precipitates insoluble hydrates or oxides (Method B). *Method A.*—A weighed or measured quantity (10 grms. of vinegar will be enough in most cases) of the solution to be examined is reddened slightly with litmus, and then treated with test-alkali until the whole of the acid is neutralised, and the colour of the litmus changed to blue (see Acidimetry).

ANTIMONY [Compare antimony compounds.]—Antimony is estimated as metallic antimony, as sulphide of antimony, antimoniate of antimony, antimoniate of sodium, or by titration, as has been explained under antimonious acid. *Principle I.* Sparing solubility of the metal in chlorhydric acid.

CANTHARIDIN.—*Principle.* Sparing solubility in bisulphide of carbon and in alcohol.

CARBONATE OF LEAD.—*Principle I.* Insolubility in cold water. *Applications:* Estimation of lead in all salts of that metal which are soluble in water, or from which the lead can be dissolved by nitric acid; separation of Pb. from Mn.

These few instances may give the reader some idea, though a very inadequate one, of the mode of treatment of the matter and arrangement of the subject. It would be impossible to enter into minute details of this work, which indeed, when completed, will be for analytical chemistry what Watts's "Dictionary" is for chemistry in general. It is not only important that the analyst should have a dictionary of all known methods from which to choose the one which seems best to fulfil the conditions and requirements of any new problem which may come before him, but there will always be needed books or tables devoted to illustrations of the various kinds of analyses which are likely to occur in practice. But if we were once in possession of a general encyclopædia covering the entire field of analysis, it would be easy to draw up long lists of these special schemes in a very few words. For example: A residual product from some of the chemical works at Stassfurt, in Germany, sent into commerce to be sold as a fertiliser, contains the sulphates of potassium, magnesium, and calcium; the chlorides of potassium, sodium, and magnesium, and a quantity of oxide of iron, magnesia, and sand, insoluble in water. But the commercial value of any given sample of the substance depends upon the proportion of potassium which is contained in it. Several methods

\* *Ann der Chemie und Pharm.*, Band cxliv. 71, 1867.



have been employed for estimating the potassium. After the matters insoluble in water have been got rid of by filtration, they might be briefly described as follows: (a.) Remove the  $\text{SO}_3$  with  $\text{BaCl}_2$ , as sulphate of barium, the Mg with  $\text{BaO}$ ,  $\text{H}_2\text{O}$ , as hydrate of magnesium, the Ca and excess of Ba with  $(\text{NH}_4)_2\text{O}$ ,  $\text{CO}_2$  as carbonate of barium, and estimate the K as chloride and chloroplatinate of potassium. (b.) Remove  $\text{SO}_3$  by means of  $\text{BaCl}_2$  as sulphate of barium, decompose the chloride of magnesium with oxalic acid, and separate Mg as oxide of magnesium; determine K as chloroplatinate of potassium. (c.) Remove the  $\text{SO}_3$  with  $\text{BaCl}_2$  as sulphate of barium; the Ba, Ca, and Mg with  $\text{Na}_2\text{OCO}_2$  as carbonate of barium, &c., acidulate the filtrate with  $\text{HCl}$ , and estimate K in the filtrate as chloride and chloroplatinate of potassium. (d.) Remove the  $\text{SO}_3$  with  $\text{BaCl}_2$  as sulphate of barium, and estimate K in the filtrate as chloroplatinate of potassium (Stohmann's process). The author of any such tables would of course give reasons why and when either one of the processes would be preferred to the others. In the appendix to the work now under notice, the author intends to give a few examples of this kind of analysis for students' practice.

The names of rare elements have been omitted from this edition simply for want of time to deal with them; and in order that the size and cost of the book might be kept within reasonable bounds it has been thought best to exclude from it all figures of apparatus, but the description of unusual forms of apparatus has been given in minute detail, so that any reader may, if he chooses, by reading the text attentively, make from the description a rough figure for his own use.

Professor Storer's work cannot fail to be a great boon to all chemists, and for compiling it we feel greatly indebted to the talented author. We trust that both the author and publishers will find their labours duly appreciated.

*Chemical Problems.* By Professor T. E. THORPE, Ph.D., Manchester: J. Galt and Co.

WE are glad to welcome this little book. It is introduced by a short preface from the pen of Dr. Roscoe, who says that he feels sure "that by no method can accuracy in a knowledge of chemistry be more surely secured than by attention to the working of well-selected problems,"—and we are quite sure that Professor Roscoe is right. We believe that Dr. Roscoe was one of the first to recognise the value of such questions, and many of our best teachers, whose papers formerly contained questions requiring merely descriptive answers, now largely employ them, and it is certain that a candidate at the examinations of the Science and Art Department, or the examinations of the University of London, cannot hope to succeed unless he possess some facility in chemical calculations.

Dr. Thorpe's little book contains 220 questions. They are well selected, and cover a considerable range, and in the case of those presenting any difficulty, explanations are given.

Most of the questions are new, but some few are taken from the examination papers of the Science and Art Department.

We notice an error in the formula for the calculation of the *calorific intensity* of hydrogen burning in oxygen, which is given thus:—

$$\frac{34462 - (536 \times 9)}{9 \times 0.475} = 6932.8.$$

Since the initial temperature of the gases is supposed to be  $0^\circ \text{C}$ .—the latent heat of steam at  $0^\circ \text{C}$ . must be employed and not that at  $100^\circ \text{C}$ ., so that the formula should be—

$$\frac{34462 - (606.5 \times 9)}{9 \times 0.475} = 6784.3.$$

We notice one other error—a misprint—on page 3. Area of a circle = diameter squared  $\times 0.78538$  should be = diameter squared  $\times 0.785398$ .

The value of the book is increased by an appendix giving a table of four figure logarithms and anti-logarithms, a table of atomic weights, and other tables of constant use in calculations.

## CORRESPONDENCE.

### NITRIC ACID DISSOLVES TIN.

*To the Editor of the Chemical News.*

SIR,—Having been aware for a long time that a mixture of nitric and hydrochloric acids, in the proportions of 12 parts by volume of the former to 1 part by volume of the latter, diluted with 13 parts by volume of water, was capable of dissolving tin in very large quantity, I bethought me of determining whether nitric acid alone had any solvent action upon that metal. Accordingly I mixed equal volumes of chemically pure nitric acid and pure water, and having poured into a clean test-tube a sufficiency of the mixed acids to ballast it and cause it to float upright in water, I set it afloat in that fluid, at a temperature of about  $36^\circ \text{Fahrenheit}$ . Taking care to keep the liquid cold, I added a fragment of pure tin of the size of a pin-head, which dissolved within an hour. Fragment after fragment dissolved in like manner, and the solution thus obtained was of a brilliant yellow colour, and perfectly transparent. Upon the application of a very gentle heat to the solution the colour disappears, and at the boiling-point the whole of the tin is precipitated as the hydrate of metastannic acid. To examine this nitric acid solution of tin it would be necessary first to pass through it a stream of dry and cold hydrogen in order to exsiccate the salt and free it from excess of acid, and afterwards to inquire into its properties. Would you oblige me by giving the above discovery publicity through your widely-circulated paper?

I have already mentioned the above facts to several chemists of my acquaintance, and all of them think the matter sufficiently important for notice in your columns.—I am, &c.,

GEORGE HAY.

31, Grove Street, Edinburgh.

### SUPERSATURATED SALINE SOLUTIONS.

*To the Editor of the Chemical News.*

SIR,—I have to thank Mr. Tomlinson for the courteous tone in which he has criticised my last paper upon supersaturated solutions.

Just at present I have not time to answer his objections, but shortly I hope to do so fully. But with respect to the doubt which Mr. Tomlinson raises as to the non-supersaturation of the solutions experimented upon, I can only repeat what I have already twice stated (see *CHEMICAL NEWS*, vol. xxii., pp. 91 and 243), *i.e.*, that I took every conceivable precaution to ensure the solutions being fully supersaturated, and that I never accepted a result until I had proved this either by exposure to the air or by the insertion of a dirty rod, and, moreover, I almost invariably worked with such an excess of salt that some was thrown down in the anhydrous form during the boiling; hence this source of error was, I think, eliminated.

It would have been perfectly useless to have made experiments upon a solution which was not supersaturated. The discordancy between my results and those obtained by Mr. Tomlinson must, as far as I can see, be explained in some other way.

In reply to Mr. Tomlinson's inquiry respecting the strength of the ethereal solutions—I may state the proportions were approximately one part oil to twenty of ether.—I am, &c.,

ARCHD. LIVERSIDGE.

Christ's College, Cambridge,  
December 6, 1870.



## MISCELLANEOUS.

King's College.—Mr. C. L. Bloxam has been appointed Professor of Chemistry in the room of the late Dr. W. A. Miller, and Mr. W. Noel Hartley has received the appointment of Demonstrator.

The Chair of Chemistry at St. Bartholomew's Hospital.—On Tuesday morning last, the candidates for the chemical chair at St. Bartholomew's Hospital were summoned to meet the House Committee of the Hospital. The following gentlemen attended:—Messrs. Dupré, Heaton, Mills, Russell, Maxwell-Simpson, and Wanklyn. After waiting in the ante-room for about an hour and a half, the candidates were called into the board room one by one, seated on a high chair, and personally "interviewed" by the House Committee. Then Mr. Cross, secretary to the Hospital, read the letter of application, and the candidate was asked if he had anything to add to the letter. In most cases he was asked a variety of questions—"His age," "Whether he could manage boys," &c., and having replied to these interrogatories he was requested to withdraw. After a slight pause, Mr. Cross called in the successful candidate and communicated to the others the name of their more fortunate companion. The name announced was that of Dr. Russell, of St. Mary's Hospital. We are told that the usual steps in the election to the chemical chair at St. Bartholomew's are—recommendation by the Medical Committee of the Hospital, election by the House Committee, consisting of some thirty governors, and confirmation by the general body of governors, which numbers some 270 persons.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

*Zeitschrift für Chemie von Beilstein*, No. 17, 1870.

Action of Phosphuretted Hydrogen upon Zinc-Ethyl.—C. Schultz-Sellack.—It is, says the author, a well-known fact that ammonia decomposes an ethereal solution of zinc-ethyl, forming zinc-amide. When phosphuretted hydrogen acts on an ethereal solution of zinc-ethyl, there is obtained a yellowish powder, which is not analogous to the zinc-amide just alluded to—viz., primary zinc-phosphine, but a substance containing carbon, so that the ether is simultaneously decomposed, as is also the case when phosphuretted hydrogen acts upon ether and chloride of cyanogen, as stated by MM. Darmstädter and Henniger.

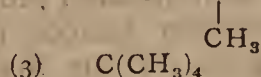
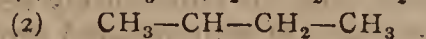
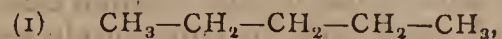
Cyanchlorhydrine of Ethyl-Glycerine; and on Monochloro-Lactic Acid.—G. Glinsky.—This paper opens with a brief *résumé* of the author's researches on the action of hypochlorous acid upon chlorvinyl. When an aqueous solution of chloraldehyde was treated with cyanide of potassium, a brown-coloured oily fluid, which is readily decomposed, was obtained, which appeared to be a fluid cyanaldehyde. This body gave, when treated with hydrochloric acid, a large quantity of sal-ammoniac, and, when afterwards treated with ether, yielded chloro-lactic acid. The probable mode of formation of this body is elucidated by a series of formulæ too lengthy and complicated for us to quote. The next following section of this paper is devoted to the detailed description of the preparation of the cyanchlorhydrine of the ethylglycerine, which preparation is commenced with the reaction of hydrochloric acid upon chlorvinyl. This yields by fractional distillation several liquids, which boil at temperatures varying from 22° to 97°. When any liquid ceases to come over at that temperature another receiver is put on, and the distillation resumed at above 97°, and continued as long as the fluid collected in the receiver becomes emulsified when dry pulverised cyanide of potassium is added to it. After being properly purified (a somewhat lengthy and tedious operation), the resulting liquid is an oily fluid of agreeable smell, sweet, but burning taste, not capable of being boiled without decomposition even in vacuum, burning with a greenish coloured flame, soluble without producing any evolution of gas in nitric and hydrochloric acids; yielding, however, with the latter—chlorolactic acid. The formula of this body, cyanchlorhydrine of

ethylglycerine, is  $C_3H_4ClNO$ . The author then treats at length on the preparation of monochloro-lactic acid, and further states that chlorolactic acid,  $C_3H_5ClO_3$ , is a solid body, crystallising in irregular shaped foliated crystals, colourless and void of smell, readily soluble in water, alcohol, and ether, fusing at 81°. It is a rather strong acid, which dissolves zinc, sublimes with partial decomposition and yields with zinc two salts, viz.: (1.)  $(C_3H_4ClO_3)_2Zn + 3H_2O$ , a solid, crystalline, efflorescent body, which, on being boiled with water, yields aldehyde; if heated above 100° the salt becomes brownish coloured, and at 190° it is decomposed, yielding aldehyde. (2.)  $(C_3H_4ClO_3)_2Zn + 3\frac{1}{2}H_2O$ , obtained by dissolving zinc at 50° in the concentrated aqueous solution of the acid, exhibits small, irregular-shaped crystals. The silver salt of this acid,  $C_3H_4ClAgO_3$ , is very difficult to prepare, since it is very readily decomposed by the action of heat and light. The salt crystallises in the shape of tufted acicular crystals. It is very prone to decomposition, for even when in hot water, it is resolved into carbonic acid, chloride of silver, and aldehyde.

Oxyisocaprylic Acid, Oxyisovalerianic Acid, and Dipseudo-propyl-keton.—W. Markownikow.—The author, describes the following substances: oxyisocapryl ether;  $C_8H_{15}(C_2H_5)_2O_3$ , a thickish, pale, yellow-coloured, mouldy-smelling fluid, boiling at about from 202°–204°; is not acted upon by a concentrated solution of caustic potassa at 130°. This ether is best decomposed by alcoholic potassa. It then yields, after proper purification, the oxyisocaprylic acid,  $C_8H_{15}O_3$ , a solid body, crystallising in needle-shaped crystals, difficultly soluble in cold water, more readily so in alcohol and ether; fuses at about 110°. The barium salt of this acid  $(C_8H_{15}O_3)_2Ba + 3H_2O$ , is a crystalline, efflorescent body. Oxyisovalerianic acid (pseudopropyl-hydroxalic acid),  $C_5H_7CH(OH)CO_2H$ , is soluble in ether, very deliquescent, and yields with barium an anhydrous salt, obtainable in semi-crystalline state. The formula of this salt is  $(C_5H_7O_3)_2Ba$ , soluble in alcohol. The formula of the silver salt is  $C_5H_7O_3Ag$ , difficultly soluble in cold water. Dipseudo-propyl-keton,  $(C_3H_7)_2CO$ , a fluid exhibiting a peculiar and strong smell. It is soluble in water and does not combine with sodium bisulphite. It boils at 123°. The author briefly states that oxyisocaprylic acid, when heated to 100° with fuming hydriodic acid, does not yield isocaprylic acid, but several iodides, amongst which is isopropyl-iodide.

Behaviour of Some of the Haloid Compounds of Ethylen and Propylen with Hydriodic Acid.—W. Sorokin.—The author first states that since Dr. Markownikow had proved that when hydracids (haloid acids) combine with hydrocarbons,  $C_nH_{2n}$ , the haloid always prefers to combine with that C-atom which is bound to the smallest quantity of H; he therefore endeavoured to try to determine by experiments how, and in what manner, two haloids would simultaneously combine with an unsymmetrical hydrocarbon. This having been premised, the author describes in detail a series of experiments, which, however interesting, are not suited for abstraction.

Hydrocarbons,  $C_5H_{12}$ .—M. Lwow.—Of the hydrocarbons  $C_5H_{12}$ , three are theoretically known. Of these three, the second, obtained from amylic alcohol, is somewhat better known. The formulæ of these hydrocarbons are:—



The author has prepared the third member of this group—the tetramethylformen, a body answering to the formula— $2C(CH_3)_3I + Zn(CH_3)_2 = C(CH_3)_4 + ZnI_2$ .

Zinc methyl is added drop by drop to the tertiary iodbutyl (the iodide of trimethylcarbinol); after a tedious process of purification there is obtained tetramethylformen,  $C_5H_{12}$ , a colourless, very mobile fluid, boiling at 9.5°, solidifying at -20° to a crystalline body, very similar to sublimed sal-ammoniac. This property of becoming solid and crystalline distinguishes this substance from hydride of amyl. The vapour density of this substance is = 2.493.

Haloid Compounds of Boron.—G. Gustavson.—Chloride of boron is readily prepared when boric acid anhydride is heated in a sealed tube for three or four days to 150°, with twice its weight of pentachloride of phosphorus. In addition to  $BCl_3$ , there is also formed an oxychloride of boron. Trichloride of phosphorus does not act upon boric acid anhydride even when heated therewith to 200° for a period of three weeks. Chloride of boron can be distilled over sodium without decomposition, and when the temperature is raised to 150°, only a trace of free boron is separated. Pulverised metallic zinc does not act upon chloride of boron even at 200°.

Action of Phosgen on Zinc Methyl.—A. Butlerow.—The author first refers to some of his former experiments on this subject, stating that zinc methyl absorbs at the ordinary temperature very slowly, and somewhat more rapidly at 100°, phosgen,  $COCl_2$ , the result being the production of a crystalline compound,  $[2Zn(CH_3)_2.C_2H_5O.Cl]$ , which, on being decomposed by means of  $H_2O$ , yields trimethylcarbinol. But since simultaneously some acetic acid is formed, the author was induced to study the reaction alluded to more particularly. The greater portion of this paper is devoted to a detailed account of the experiments instituted for the special purpose of determining the moment when acetic acid is formed. The result of careful investigation in this direction was, however, negative. The author therefore comes to the conclusion that the acetic acid formerly noticed was due to the decomposition of trimethylcarbinol.

Constitution of Some Non-saturated Hydrocarbons.—A. Butlerow.—The introduction to this paper treats on the theory of the constitution and atomic and molecular structure of the hydro-



carbons, which are termed non-saturated. The greater portion of the essay is, however, devoted to a lengthy description of a series of experiments made with the view of elucidating the various theories which have been propounded on the subject.

**Some of the Reactions Exhibited by Mercuriallyl.**—M. Krawsowsky.—The author states that at the suggestion of Professor Butlerow (University of St. Petersburg) he was induced to try to prepare some derivatives of the combination  $(C_3H_5)HgI$ , and also the bodies  $(C_3H_5)_2Hg$ , and  $(C_3H_5)(C_2H_5)Hg$ . The two last-named could not, however, be made. When a mixture of 15 grms.  $C_3H_5I$ , and  $1\frac{1}{2}$  grms. of acetic ether were heated with sodium amalgam, there was formed  $(C_3H_5)_2HgI$ , a volatile body exhibiting the smell of diallyl. If  $Hg(C_3H_5)I$  is heated to  $100^\circ$  in a sealed tube, along with an aqueous solution of KI, there is formed diallyl and  $Hg$ ,  $2C_3H_5(Hg)I + 2KI = C_6H_{10} + Hg + HgI_2 \cdot 2KI$ . The author states further that when a mixture of  $(C_3H_5)_2HgI$  and  $C_3H_5I$  is heated for three days with iron filings up to  $100^\circ$  in a sealed tube, the greater portion of the  $(C_3H_5)_2HgI$  remains unchanged. With pulverised zinc the result is somewhat different, for when  $Hg(C_3H_5)I$  is treated with  $Zn(C_2H_5)_2$ ,  $Hg$  is separated and mercurethyl formed without evolution of any heat or gas. The reaction is represented by—  
 $2Hg(C_3H_5)I + Zn(C_2H_5)_2 = Hg(C_2H_5)_2 + Hg + C_6H_{10} + ZnI$ .

**Recovering of Iodine from Substances which Contain that Element.**—Dr. F. Beilstein.—The author first states that when only iodine is present, the separation of that substance does not involve any difficulty, and therefore the process to be detailed refers to the separation of iodine from substances simultaneously containing bromine and iodine. The sufficiently concentrated saline solution (containing of course iodides, bromides, and perhaps chlorides) is acidified with sulphuric acid, and a current of nitrous acid gas, obtained by heating one part of starch (dry) with six parts of crude nitric acid, is then introduced into it. This operation requires cautious management, so as to obtain a regular supply of gas. The effect upon the solution is the separation of iodine, which is separated by filtration, as directed by Bunsen, washed with cold water, and dried over sulphuric acid. If it is desired to separate the bromine, if present, the filtrate is first heated in a basin, for the separation of any iodine which might have been left dissolved, and the fluid is then distilled, with a mixture of sulphuric acid and manganese.

## NOTES AND QUERIES.

**Orange-Lead.**—Can any of your correspondents favour me with particulars of the manufacture of orange-lead, or of any published work from which such may be obtained.—J. DODD.

**Separation of Tarry Matter from Gas-Water.**—Can any of your readers inform me of a good mechanical method for separating suspended tarry matter from gas-water, of from  $8^\circ$  to  $10^\circ$  Twad., obtained by passing the water a number of times through the "scrubbers."—GAS ENGINEER.

**Pyrotechny.**—(Reply to Ernest J. Whiteford).—Consult Schubarth's "Standbuch der Technischen Chemie," vol. i. Under the heading of "Powder Manufacture," you will find a rather complete bibliography on your subject. You will find the work at the library of the Commissioners of Patents.

## MEETINGS FOR THE WEEK.

- MONDAY, 19th.—London Institution, 4. Dr. Odling, F.R.S., "On Chemical Action." (Educational Course.)  
 ——— Medical, 8.  
 TUESDAY, 20th.—Institute of Civil Engineers, 8. (Anniversary.)  
 WEDNESDAY, 21st.—Society of Arts, 8.  
 ——— Geological, 8.  
 THURSDAY, 22nd.—Royal, 8.30.  
 FRIDAY, 23rd.—Quekett Microscopical Club, 8.

## TO CORRESPONDENTS.

\* \* \* Our Publisher requests us to remind Subscribers that, if their Subscriptions for the ensuing year are sent to him in advance, the amount for one year will be 18s., no postage being charged; but if accounts are sent from the Office, the subscription will be £1.

**Climax.**—You will find the tables you require in the appendix to Miller's "Elements of Chemistry."

**A Reader.**—Write to the Secretary, Burlington House.

**W. King, W. H. Dean, and others.**—The work on "Dyeing" is not published yet; it will be announced as soon as it is ready.

**A Constant Reader.**—You need not hesitate to place dependence upon anything issuing from the principal of the firm you name.

**J. Fordred.**—Your communication has been received.

**W. F. Q.**—Griffin's "Chemical Handicraft" will give you particulars of several of the furnaces.

**L. M. Montgomery.**—Your best plan would be to get a copy of the journal from which our notice was taken.

**W. Hope.**—Received, with thanks.

**A. and M. Zimmerman.**—Received.

**J. Bottomley.**—Your communication is unavoidably postponed till next week.

**Rev. H. Highton, M.A.**—Next week.

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**Challenge to the World.**—The *Bristol Daily Times and Mirror*, August 5th, has the following:—Messrs. J. C. Swan and Co., of 16, Queen's Square, in this city, have invented a pocket microscope, which is a marvel in all that such an instrument should be. It has great power, remarkable definition, and does not require focussing. The cheapness of the article will make it exceedingly popular when its merits are more widely known. It is called the "Bristol Microscope," and is a great credit to the inventor, as much for its extreme simplicity as its power.—The *Western Daily Press* says: The Bristol Microscope has a magnifying power of 20,000 times, &c., &c.—The *Western Daily Telegraph* says: The Bristol Microscope is the most compact and useful scientific instrument we have ever seen; it possesses extraordinary power, and is very easily managed, &c. The price of the Bristol Microscope is only 2s., or free by post, with printed directions, for 28 stamps.—Address, J. C. Swan and Co., Opticians, 16, Queen Square, Bristol.



# THE CHEMICAL NEWS.

VOL. XXII. No. 578.

## ON THE SEWAGE QUESTION.\*

By EDWARD C. C. STANFORD, F.C.S.

(Concluded from p. 291).

Now, in estimating the value of a manure, Her Majesty's Commissioners attach little importance to farmers' certificates, but value it entirely by chemical analysis; this is the only fair way, because it shows exactly what it is worth in open market. But in comparing the value of irrigation with that of any chemical process dealing with sewage they bring in another and, I submit, an improper element, *i.e.*, the total profit of the farmer. This is unfair; the farmer buys his manure—say, made from bones, or, say, from excreta—by analysis at its market value, and his living is made out of what that investment produces from the land. The irrigationists have no right to put themselves in his place, reap his profits, charge themselves nothing for the sewage, and call that "making it pay." In one of the accounts quoted in Her Majesty's Commissioners' Report, I see the "right of shooting over the farm" actually entered as an irrigation profit! What will the farmer give for the sewage? Of course, much less than its analytical value, where, as with us, the water is not wanted. Farmers in the west of Scotland, although, no doubt, they can grumble as well as their English friends, very seldom have to grumble for want of water; and, at any rate, in their case, the value of the manurial matter will be in inverse geometrical proportion to the quantity of water it is dissolved in. I repeat geometrical, not arithmetical.

Our country has got into its sewage difficulties from the extreme persistence with which our engineers have clung to the idea that water is the great purifier. Hence, we began with the water-closet, combined with a cesspool, but the frightful results of this provision for the contamination of our drinking water were soon apparent. We could not stop there, we must go further, and convert the cesspool into a net-work of gigantic sewers.

Instead, therefore, of having one deep cesspool for each house, exposing a comparatively small surface, we now convert these into one shallow stream of large surface and underlying the whole city. Therefore, we can have no more wells; we must draw our drinking water from one great source far away from contamination.

Professor Corfield says our sewers must be porous to the drainage water above, and impervious below. Practically we know that all leak both above and below, the sewer gases diffuse upwards, and the sewer liquids find their way downwards.

Sewage gas will pass easily through brick walls, and the action of the sewage on the soil pipes diffuses them throughout the house. The British Association Committee says that no improvement has taken place in sewer ventilation.

I spoke of water in a former paper as "a mere carrier" of excretal matter; we find it now a most powerful diffuser, spreading far and wide its pollution.

It is idle to talk of carrying the sewage without decomposition to the land. Both the solid and fluid excreta are acid when voided; the former will remain several weeks without decomposition, and the latter several days; mix them or add water, and the mixture becomes alkaline in twenty-four hours, and in that time it absorbs oxygen rapidly, and is in a full state of decomposition. Again, the gases given off from this mixture are of the most dangerous character—light carburetted hydrogen is one; and this is one of the most diffusive gases with which we are acquainted, and

we cannot keep it and the poison germs which it diffuses out of our houses. The sickly odour of sewer gas is too well-known in all houses where there are water-closets.

Now I am quite prepared to admit that the water supply and the drainage arrangements are good and may be left for house-washing waters or surface drainage, and the slight amount of oxidation from the surface of the river may be sufficient to purify this. But when we look at this gigantic scheme as a scientific means of removing that small portion of dirt we call house-sewage, I say that our sanitary reformers have been looking at it through a water medium, and therefore seen it highly magnified. I only wonder that they have stopped here, and not always insisted on the removal of our house-ashes by the same means; the amount to be removed is about the same, and it would not pollute the water.

Let it not be supposed that the water-closet can ever be universal; all its evils are aggravated in hot climates, and in very cold climates it is impossible. The bursting of a soil-pipe in a dwelling house is a calamity which would soon put a stop to the use of the closets if it occurred often with us. Even Professor Corfield admits that the water-closet ought always to be ventilated by a window or an outside wall, and all know that a water-closet in a sick room in connection with a main sewer would be highly dangerous.

The healthfulness of irrigated fields is a much disputed question, but Professor Corfield easily dismisses it. I must, however, quote Dr. Spencer Cobbold, F.R.S., as the highest authority on the subject. In a pamphlet on "A New Entozootic Malady arising from the Utilisation of Sewage" he says—"The wholesale distribution of tape-worm eggs by the utilisation of sewage on a stupendous scale will inevitably tend to spread abroad a class of diseases some of which are severely formidable."

He states that, in Egypt, one-third of the population suffer from a small parasite in the blood; that this disease (Helminthiasis) is "terribly fatal," and that it has already been found by Dr. Harley in this country. He states his conviction that it is quite possible "twenty years hence, this parasitic malady may be as prevalent in this country as it is now known to be in particular sections of the African Continent." Coming from such an eminent authority the pamphlet presents a sufficiently terrible picture to make any sanitary reformer pause and consider if the country should be committed to even the bare possibility of such awful visitations. If many of our Ayrshire friends peruse it, they will resist the threatened inundation of Glasgow tape-worms as they would the most terrible army of invaders. And yet my friend Mr. Hope, V.C.,\* of the British Association Irrigation Committee (and the most committed to irrigation), has the pluck to suggest "a convalescent hospital for diseases of the chest in the middle of his sewage fields, guaranteeing to the patients a certain number of irrigations in the month with genuine unadulterated London sewage," "where London beauties might come out to recruit their wasted energies at the close of the season, and, attired in a *costume de circonstance*, with coquettish jack-boots, would, perhaps, at times, listen to a lecture on agriculture from the farmer himself while drinking his cream and luxuriating in the health-restoring breeze." The pictures are somewhat different; Dr. Cobbold would, probably, consider this seeking the "diet of worms." The distinguished advocate of sewage irrigation is not the only "Hope" that has "told a flattering tale." On the other hand, Professor Corfield states that phthisis is greatly decreased by efficient drainage, *i.e.*, I suppose, increased by irrigation swamps.

In carefully reviewing the effects and defects of water carriage, I have been forcibly led to consider that to dry up the excreta is the safest, easiest, and best method of removal; it certainly is the only one by which we can ever expect to realise its full value. Now let us examine what these reports have to say against it.

\* Read before the Glasgow Philosophical Society (Sanitary Section), Nov. 9th, 1870.

I quote from his paper read before the Society of Arts, February 23rd, 1870.



I scarcely know how to criticise the Royal Commission Report on this subject, because their objections apply only to the ash-pit and privy system as carried out in Lancashire, and we must agree with their conclusions, but the evidence does not in the least effect a proper dry closet system such as that I propose. In fact, they speak highly of some places where Moule's earth closets are used.

Professor Corfield, in speaking of the earth closet, admits that "with supervision the closets do not get out of order," but he has to admit, also, that they had to be substituted for water-closets, at "Dorset County School, because the water-closets always got out of order from things being put into them, and from the apparatus being broken," which, he says, was "because they were not simple and self-acting." But Dr. Buchanan describes the effect of the change as to have actually reduced cost of keeping of from £3 to 10s. per annum, and to produce manure worth 15s. per head per annum (which, however, Professor Corfield does not believe possible). A low fever, which visited the town two years following, never entered the school. The simple water-closets he recommends are used at Liverpool, but the supervision is undertaken and the rules enforced by the sanitary authority.

In one of the largest cotton mills in Scotland, the owners were obliged to give up the use of water-closets on account of their offensiveness. The cost of the pure water for the closets was £70 per annum; which was worse than lost, as it was returned to foul a pure stream. Dry closets have been substituted, the offensiveness indoors is entirely removed, the purity of the stream is maintained, and the product of the closets realise £150 per annum. Can any evidence be stronger?

As regards pollution of rivers, Dr. Frankland has shown by numerous comparative analyses that the sewage of so-called midden towns is even stronger than that of towns where water-closets are universal. Now this is a result which cannot surprise us when we remember that in all these towns the fluid excreta goes into the sewers; *i.e.* eight-ninths of the pollution, and unaccompanied by the large dilution of water from the closets. In fact, he adds, "connected as the middens usually are with the sewers, no inconsiderable proportion even of solid excrement, partly in solution and partly in suspension, does actually find its way into the sewerage system." One of the British Association Reporters instanced a town where the excreta was collected in ashes and then carted out to repair the roads. I need scarcely say that this is not the dry system we advocate, and I admit at once that if the urine is not to be collected, the dry system is a failure. Moreover, in all the midden towns referred to, from admixture with a large quantity of valueless material, a considerable amount of manure of a poor value is produced; the highest of which, that of Salford, only realises 7d. per head per annum, and 1s. 8d. ton, and in all cases the cost exceeds the produce.

Glasgow is better than this, say 2s. 6d. per ton, and 2s. per head. But even here, from the enormous quantity of ashes mixed with it, the police manure is obliged to be sold at a low price on account of the carriage. The whole system of removal is, however, infamous, and must be highly prejudicial to health. The mistake lies in the material used; instead of being the cheapest and most bulky, it should be the dearest and the least bulky. It is in this direction that I complain of there having been no investigations: we have a large choice of deodorisers, if we deal direct with the material, and without the intervention of water. For while the advocates of a wet system must necessarily use water, those who advise a dry system are not confined to the use of earth, which may not in the end be the cheapest.

The best is, I believe, what I have introduced under the name of X-charcoal, or charcoal derived from carbonised excreta. The quantity required is less than a quarter the amount compared with earth, and every city has its own source of supply; thus the two constant objections to the earth system are at once done away with.

In each of the closets I have a small earthenware urinal with a tube passing under the floor connected with the pan of the closet, and into this the chamber urine of each floor is emptied (this is kept entirely free from odour by two or three good sized pieces of wood charcoal). The total quantity to be dealt with is easily estimated, but as my former estimates, based on Lieurnur's estimate, differ from those adopted by Her Majesty's Commissioners, I append comparative statement, and also that of Professor Parkes, a high authority.

*For 100,000 Persons, Average of all Sexes.*

	Weight in cwts.			Value in £.	
	Lieurnur.	Parkes.	H.M.C.	Lieurnur.	H.M.C.
Fæces ..	78,000	50,919	64,937	5,800	4,263
Urine ..	484,000	814,732	840,637	35,800	28,140
Total ..	562,000	865,651	905,574	41,600	32,403

*Per Head per Annum.*

	Weight in cwts.			Value in shillings.	
	Lieurnur.	Parkes.	H.M.C.	Lieurnur.	H.M.C.
Fæces ..	0.78	0.50*	0.64	1.16	0.852
Urine ..	4.84	8.14	8.40	7.16	5.628
Total ..	5.62	8.64	9.04	8.32	6.480

*Per Annum.*

	Weight in tons.			Value per ton in shillings.	
	Lieurnur.	Parkes.	H.M.C.	Lieurnur.	H.M.C.
Fæces ..	3,900	2,546	3,246	29.74	26.26
Urine ..	24,200	40,736	42,032	29.54	13.38
Total ..	28,100	43,282	45,278	29.68	14.31

The calculations of value are mine, and are based on the usual estimate established by the last sewage commission at 8s. 4d. per head per annum as obtained from the analyses of sewage. This was made up on the analyses of Messrs. Lawes and Gilbert, each individual contributing per annum in—

Urine .. .. 11.32 lbs. ammonia = 7s. 3d.

Fæces .. .. 1.64 lbs. ammonia = 1s. 2½d.

8s. 5½d.

Taking Lieurnur's estimate of one cubic foot per head per annum solid, and 9 cubic feet liquid, rating also the relative value of 1 to 6, making 1s. 2d. per head for the former, and 7s. 2d. for the latter. Lieurnur's estimate allows a margin for loss.

I have calculated the values of Her Majesty's Commissioners' Report by taking the data in the table of the amounts of organic nitrogen and of phosphates, and valuing the former at £68 per ton, and the latter at £15 per ton, the values by which in the same report the manure of the A B C process is estimated.

The following shows the amounts in the table for 100,000 people:—

	Weight in cwts.			Per cent.		
	Organic nitrogen.	Potash.	Phos-phates.	Organic nitrogen.	Potash.	Phos-phates.
Fæces ..	957	649	1347	1.47	1.00	2.070
Urine ..	7531	2521	3380	0.89	0.30	0.402
Total ..	8488	3170	4727	0.937		0.522

It will be seen that the values given only allow 6s. 6d. per head per annum, or 14s. 4d. per ton. The value of the potash which I add to the table is, however, 3170 cwts. at 20s. = £3170, and makes the total value = £35,573; or 7s. 1d. (7.114) per head, or 15s. 8d. per ton (15.68).

The magnesia and the other salts would no doubt bring up the value to the usual 8s. 4d., which, even at the high

\* Parkes calculates the solid excreta of vegetarians at more than double this, or 12 ozs. per day.



quantities estimated, would give the manure an average value of 18s. 5d. per ton. The outside quantity to be removed, therefore, inclusive of all urine, cannot exceed 9 cwts. per head per annum, and its value cannot be less than 18s. per ton. Now, even at this high estimate the removal does not exceed that of the house-ashes. Taking the city through, for 500,000 inhabitants, the daily removal would be, at 300 days in the year (225,000 tons per annum), 750 tons. One high authority, Baron Liebig, estimates the annual value of the excreta per head (London sewage of 3,000,000 = £4,081,430) at 27s. 2d. This would make the excreta worth 60s. per ton. Even now, however, we find, where the earth system is thoroughly and efficiently carried out, Professor Corfield says the manure realises "above its possible value," and there can be no doubt whatever that if the profits of the farm are to be added, as in the case of the irrigators, the advantage would be enormously on the side of the dry system.

Taking however, the lowest computation, and putting the value of the excreta at 18s. per ton, every one must admit that it will pay to cart it away. X charcoal has a manurial value of £5 per ton, and an average composition—

Chloride of sodium * .. ..	4 × 1 =	4
Chloride of potassium .. ..	8 × 10 =	80
Phosphate of lime .. ..	25 × 15 =	375
Carbonate of lime .. ..	5 × ½ =	2½
Carbonate of magnesia .. ..	5 × 5 =	25
Carbon .. ..	43 × 2 =	86
Silica .. ..	10 × ½ =	5

100      577½  
(Equal to £5 15s. 6d. per ton.)

This manure contains all that is necessary for plants except nitrogen. The effect of mixing one ton of it with one ton average excreta, is to obtain when dry 25 cwts. of manure having nearly the above composition, with the addition of nitrogen = 6 per cent sulphate of ammonia, and worth £6 per ton. The total gain being 25 cwts. × 6 = £7 10s. = 30s. per ton of excreta added, *i.e.*, my original estimate of its value. Of course this can be fortified by re-use, or by adding the ammonia obtained in the distillation, to almost any extent. In fact, one of the analyses quoted in my former paper shows a charcoal retaining nitrogen equal to 105 per cent of sulphate of ammonia. But in addition to its actual manurial value, by re-burning at any rate that portion of the product which is required to replenish the closets and keep up the supply for the city, I obtain some new products of value, which have never yet entered into the calculation. These are acetate of lime, tar, and gas. The former arises from the acetic acid which comes over from the destructive distillation of the vegetable residues ejected in excreta; the two latter mainly from the fat passed in the excreta. I have before shown that we are only employers of fat as we are employers of nitrogen and phosphates, and though a portion is consumed, especially in winter, in supplying fuel to our bodies, yet a large portion is found in the excreta. This appears as far in the distillation. This little item in Glasgow would amount to seven tons a days. The acetate of lime is as valuable as the sulphate of ammonia.

I need not here go further into the chemistry of the process, as that has been fully investigated, so far as known products are concerned, and an exhaustive series of analyses of the results has been published in my former papers submitted to the Chemical Section of the British Association, and published in full in the CHEMICAL NEWS. The analyses speak for themselves, and the statements have never been refuted.

Now, with regard to the healthfulness of the dry process of removal, I can find no evidence of any kind which in the least tells against it. The germ theory of

disease, now so generally believed in, is all in favour of a system which localises the poison and prevents its spreading. In opposition to water, which certainly spreads the germs, of that there is unlimited proof; the ordeal by fire to which I subject them must be absolutely destructive. No one knows exactly what the germs of cholera, scarlet fever, &c., are, but all admit them to be organic, and therefore all must admit that subjection to a red heat in an iron retort must destroy their vitality. Only last month, at a meeting of the London Association of Medical Officers of Health, Dr. Druitt, in his opening address, alluded to the prevalence of scarlet fever in London. "He believed scarlet fever to be emphatically a product of sewer gases." Dr. Rogers thought "scarlet fever to be more under control than any of the preventible diseases. The reason of its spreading so rapidly in some districts was that the excreta were not properly got rid of."

Dr. Tilley said that he had recently inspected forty or fifty houses into which there was a constant admission of sewer gases. (All this in London, where £5,000,000 have been spent on sewage with all the latest improvements, and gigantic pumps for lifting the sewage and leaving the gases behind.) Dr. Druitt said that sewers require disinfecting by drenching with carbolic acid in large quantity. Now, if it must be disinfected, how easy to add the disinfectant at the source.

I claim, then, the most extended benefit to health of towns by the adoption of this process.

As I propose, however, that the vault of a private house should only be emptied once a year, and as some may fear injury to health by allowing a ton or two of the X mixture to accumulate, I append an extract of a letter from W. Gilbert Hickey, Esq., C.E., of Calcutta, July 9, 1870, which should allay all fear on this head, and will show the extraordinary power of X charcoal. He says:—"I put this to a very crucial test. I placed an iron cylinder in my office, I perforated the bottom and placed a thin layer of charcoal poudrette, or poudrette coke, *i.e.*, the residue left in the retort after carbonising excreta. I then sent to the public latrine, and had 1 cwt. of human ordure poured in. On top I placed a layer of poudrette coke, about two inches thick. It remained in the room for six weeks, and there was no nuisance of any kind."

Now, if 1 cwt. of human ordure can be kept in an office in Calcutta so long as this, completely deodorised by a slight layer of X charcoal, you may believe that nothing can be more inoffensive than a mixture of equal parts of each, such as I propose.

Now, as to the application to houses of the dry system, I deny that it requires any more supervision than the water-closet system.

One great advantage the householder has by using this process is, that if there should be any odour in his closet he has the remedy in his own hands. One of his servants has, perhaps, emptied some chamber slops into the urinal, without lifting the handle of the closet and allowing a charge of charcoal to fall. He has only to do this and the closet is at once deodorised. Now, with the water-closet, as the odour is due to sewer gas, the common method of letting down quantities of water only aggravates the evil, for the opening of the valve allows more gas to escape into the closet. For invalids the dry system is invaluable, and, in fact, absolutely necessary. I would request any who are not convinced of its value, or foresee any difficulty in applying it to towns, to read an American work on "Earth Sewage," by G. E. Waring, or inspect our arrangements at Dalmuir.

I understand that the householder is to have the use of the deodoriser for nothing, and the house to be visited by the "golden dustman," as I may call him, but once a year. The quantity of charcoal required being equal to that of the excreta removed. The method could be easily adopted to improve the removal of the town manure, with great advantage to health. The loss of Glasgow working men and women from ill-health and sickness must be

\* Common salt itself an efficient disinfectant, always exists in X charcoal, but in variable quantity.



enormous, and the consequent loss of work of each person must be felt by the whole city in one form or other. Our town authorities are now, I believe, really awake to the alarming reports of the *Daily Mail* commissioner. I would quote, however, the best paragraph in Professor Corfield's report, and address them in the words of Mr. Rowe:—

"The man who in a crowded street is living in filth and breathing a putrid atmosphere, or who makes that street a receptacle for the offal which he casts from his dwelling, becomes an instrument of danger to his neighbour by spreading infection, and he not only hazards his own life but endangers that of others. The man who erects a flimsy edifice in a crowded thoroughfare, which in its falling may destroy life, should be prevented doing so, and he who constructs a house to let for profit, and pays no attention to those matters which are essential to comfort, but, on the contrary, so constructs it as to engender fever and endanger the lives of his tenants, all these are cases where, with propriety and in justice, the legislature ought to interfere, and to insist upon such a mode of construction as will not endanger human life."

### ON FERMENTATION.\*

By Professor A. W. WILLIAMSON, F.R.S.

(Continued from page 293.)

To return to our experiment. This glass vessel is now full of the gas, and by applying a taper which been lighted and blown out, but is still glowing, we shall find, on putting it into the jar, that it immediately ignites, which is the ordinary test of oxygen gas. By the aid of that theory, which has been discovered since the time of Liebig's suggestion, this one case of apparently anomalous action has been proved to be a perfectly normal and regular case of combination, and the same kind of thing has been done with regard to other cases of the same description.

A number of other processes which he classes with these may be shown to be due, not to any exceptional force that is at work in these cases, not to the force of any particular contagious action among chemical substances, but to the ordinary forces which induce chemical combination in the cases best known to us. Liebig's theory of contagious action has been alluded to, by a high authority in this country upon philosophical matters, as being a law of chemical action of a generality comparable to the law of gravitation in astronomy, and for that reason, if for no other, it must be of considerable importance to know what bearing our most advanced knowledge has upon that law. I dare say you see the connection between it and the case of fermentation. I will not go into particulars further than is necessary, in order to show you the general analogy.

First, I will take the case of alcoholic fermentation, as being the case best known. The ferment consists of little cells—which I hope I shall be able to show you at our next meeting—each one containing several chemical compounds, but itself a little living being. I will not say at present whether they are animals or plants. When you have these little organisms in water, or sugar, or in any moist substance, they are constantly, and of necessity, undergoing decomposition. You may arrest the decomposition by various agents, but if you do so, you kill them, or suspend their activity as yeast. No case is known to us of their acting like yeast without undergoing at the same time a process of chemical decomposition—being broken up into simpler substances than those which were contained in them. I pointed out, last week, that the sugar which is being decomposed by the yeast is by that process being broken up into substances which were contained in it, and that was what Liebig noticed. He said that this yeast is a substance which tends to decompose—it is

breaking up into simpler substances, and it induces in these particles of sugar which are in contact with it a decomposition similar to its own. The action which it is undergoing is contagious, and passes over to the contiguous particles of sugar; and he adduced cases like that of oxygen, as affording analogies among simple well-known bodies. I think what I have said with regard to the case of oxygen will be sufficient to show you that in those simple cases the idea of contagion is certainly not applicable.

A foreigner, who was describing some time ago the luxuriance of the crops in America, spoke of a bushel of *mice* being sown in a field, and a hundred bushels of *mice* being reaped. Of course, what he meant to say was *maize*, or Indian corn; but I am reminded of that anecdote by the necessity I am under for a moment of asking you to consider for a while some living beings under their general functions only. Suppose you had a bushel of actual English mice, and you put them into a granary full of corn. There clearly would soon be a great change. You are supposed to know nothing more about the particular organisation of these little beings than you know about the particular organisation of the little yeast cells. You know that these little things eat grain, and that in place of the grain which they eat there appear various products of decomposition, which can be easily collected and examined. They give off carbonic acid, and so forth, and if you examined the state of that granary after a time, you will find a chemical change, or rather a set of chemical changes, going on in the organisms of these mice. The substance of which they consist would be actually wasting away; they would be giving off carbonic acid, and nitrogenous and other products. And if you also examined the state of the corn which was there at first, you would find that it finally passed over into these same products; and I say that the theory of contagious action is as much applicable to the action of the bushel of mice in the granary full of wheat, as to the action of the yeast cells upon a solution of sugar. There is, in the one case, as in the other, an assimilation by the living organism of the material upon which it acts. The materials undergo certain changes, of which the general results are known to us, but of which the particulars are, I may say, in the main almost completely unknown. As to the processes by which these products are formed, it is as well to say that we do not know them. We know a little here and there about them, but it is nothing compared to our ignorance; therefore the resemblance is the more striking, and if we were to believe in the contagiousness of chemical action as applied to the case of the assimilation of sugar, by a ferment, and say the ferment gives off alcohol and carbonic acid, and that sugar is also resolved into alcohol and carbonic acid, we should really be describing in its general features a process analogous to that which I have just now mentioned; such a general analogy would be readily admitted by those who go into the particulars of the process, but I think it is of particular importance to have in addition to it something more practically useful to guide us in understanding chemical reactions. For that purpose I will take one or two chemical reactions of an exceedingly common kind. For instance, I will again take that chromic acid solution which I just now employed. Here you see is the green residue which I told you would be produced; I again take some of this chromic solution, throw some of it into water in this jar, so as to visibly tinge the water red; I will slightly acidulate the liquid by oil of vitriol, and I will then pour into the mixture (which I will describe as chromic acid dissolved in water, for the potash which was present is taken away from the compound by the sulphuric acid), a substance which I will merely describe as being greedy of oxygen, sulphurous acid. If Liebig's theory of contagious action were generally true in chemical action, you would, no doubt, expect that this sulphurous acid, in taking up oxygen, would make the chromic acid also take up oxygen. It is quite possible for the chromic acid to do so, for that

\* The Cantor Lectures. Delivered before the Society of Arts.



blue substance which we had in this jar at first was nothing but chromic acid with oxygen added to it. But instead of this, we shall have at once a reduction of the chromic acid to deep green, which I dare say appears to you almost black. It is precisely the same thing as that pale, dirty green which you saw before, but in its concentrated state. There is no oxygen taken up by the chromic acid, but it at once loses oxygen. This sulphurous acid wanted to combine with oxygen, and it tore away at once some of the oxygen from the chromic acid, and there was in this chromic acid a process, not similar to that which the sulphurous acid underwent, but a process precisely opposite to it—one combined with oxygen, while the other lost oxygen—and if you examined the liquid, you would find that the sulphurous acid which took part in the process, and has taken up oxygen, is now in the form of sulphuric acid. Again, I have here some granulated zinc, which will very easily evolve hydrogen, particularly when its activity is stimulated by throwing a little copper vitriol on to it. After adding a little water, I will throw in a little oil of vitriol, so as to get an evolution of gas. Then I have here a solution which I think must look black to you, except at the edges, which is a solution of a beautiful salt called permanganate. It is used for deodorising certain fetid waters, and I might compare it to the chromate I was using just now. It consists of an acid of the metal manganese. If I throw some of that into the mixture which I have just prepared, and leave it for a short time, and then examine it, we shall find that, instead of being induced to give off hydrogen like the other body, which is doing so vigorously, we shall find it will do the opposite, and will combine with hydrogen; and the colour which belongs to it, and which can be recognised so easily, will disappear, because hydrogen will be taken up by its oxygen, and it will be reduced and brought down to a substance containing comparatively little oxygen. There, again, as in the previous case of the chromic acid, we find that there is a kind of chemical polarity in the general mode of action, that the one substance acted upon does precisely the opposite of the other. There is no tendency in this case to do the same thing, but the two substances acting upon one another do precisely the opposite, the one taking up what the other loses. Not only is that the case in the instance of the action which I have mentioned here, but in a great number of other cases of considerable interest and importance—bodies which act chemically with considerable energy when allowed to do so, are prevented by others from so doing when those others are trying to do the same thing. If, for example, we put metallic copper into nitric acid, the copper would dissolve with immense energy; it would undergo what I might call a process of combustion. Again, if I put mercury in contact with the acid, the same thing would occur; it would be dissolved almost as rapidly as the copper. But if I put the two together into nitric acid, the copper prevents the mercury from undergoing combustion; and so far from encouraging it to do the same thing, it actually takes from it the power which it possessed before of undergoing a combination of that kind. And more than that, if I take mercury which has been burned—a solution of mercury in the form of corrosive sublimate—and put copper into it, the copper will actually unburn it, or make it come back again from the point at which it had got, and throw down the metal. You can see the process which takes place; on putting a strip of clean red copper into the solution it becomes grey, and throws down the mercury from the solution. So far from encouraging the mercury to oxidation, it makes it do the opposite to that which it otherwise had a tendency to do.

Again, I will take some of this solution of copper—it ought to be some of the very solution which is being made here, where copper is being dissolved at the expense of mercury—and if I put into it a piece of common iron, perfectly clean and white, it will very speedily combine; and I cannot express its functions in combining better than by saying that it will make

copper uncombine, for the copper which was burnt is now being unburnt.

If we go carefully, with the knowledge of their particulars, through the best known chemical processes, we find that there is, as a rule, a force at work which I might describe as polarity—a tendency among contiguous particles which are acting on one another to assume functions which can be best characterised as being opposite to one another. Whatever the one is doing, the other is doing as nearly as possible the very opposite of it, and any tendency to do like work I know not of. There are, however, cases which would appear to be favourable to the notion of contagious chemical action. If I blow out that gas-burner, still letting the gas escape, and then bring near to it a burning splint, it will set fire to the gas, and the same with a candle-wick if I bring close to it a burning match—the match, which is burning, communicates to the wick the process which it is undergoing—but the explanation is this, it does so merely because of the high temperature which it has attained. If by any other process, such as concentrating the rays of a powerfully-heated surface by means of a lens, I raise the temperature of the gas to that point at which it is capable of combining with the oxygen of the air, it will do just as well. The accident that the high temperature is communicated by the burning splint has nothing to do with the process.

There is one other remarkable instance which I must give you, to show you the difficulty in some cases of analysing these phenomena. It is the case of the metal platinum, which I can hardly describe better in general terms, as regards its properties, than by comparing it to gold. It is what is termed a noble metal; it does not dissolve in any ordinary acid; you might boil platinum in nitric acid for any length of time and it would not dissolve. On the other hand, silver is a metal which dissolves readily in this acid, and if you melt silver and put platinum into it, it will also melt, and you obtain a compound of the two metals mixed pretty uniformly together. It was noticed that when such a button of platinum and silver is put into nitric acid, not only does the silver itself dissolve, as you would expect, but some of the platinum also dissolves with it; not the whole, but a portion. That seems, at first sight, favourable to the theory of contagion; it seems natural to suppose that the silver in dissolving has communicated the same tendency to the platinum, and made some of it dissolve. But that explanation will not do, and for this reason. When platinum is combined with anything else, I care not what, its properties are not the same as when uncombined. The very essence of chemical combination is that the particles which are in intimate contact unite, and that the compound possesses different properties from the original elements. We know that metals combine with one another; there are many cases known to us of the forcible union of metals, and we have no right to suppose in any case, unless we have actual proof of it, that a metal is present in such a compound with its ordinary properties. Therefore, it is not free platinum, but a compound of platinum and silver which dissolves, and there are some compounds of platinum which dissolve in water, and others which dissolve in nitric acid, so that this process has really nothing to do with contagious action.

(To be continued).

London Institution.—At a meeting of the Board of Management of this Institution on Wednesday, Dr Henry E. Armstrong was appointed Professor of Chemistry, an office once held by Mr. W. R. Grove, Q.C., and subsequently by Mr. J. Alfred Wanklyn. Dr. Armstrong studied chemistry under Professors Hofmann, Frankland, and Kolbe, and has been associated with Dr. Frankland and the late Dr. Matthiessen in original researches. We understand that classes for Practical Chemistry will be formed at this Institution early in the new year.



## CHEMICAL TABLES ACCORDING TO THE THEORIES OF MODERN CHEMISTRY.\*

By Professor ALBERT R. LEEDS.

(Continued from p. 242.)

TABLE II.—ATOMIC WEIGHTS ACCORDING TO THE MOST IMPORTANT WORKS UPON CHEMISTRY.

H = 1. Rammelsberg has O = 100.

Element.	Ancient Chemistry.					Transi- tion.	Modern.						
	Graham.	Miller.	Gmelin.	Rammels- berg.	Fresenius.		Watts.	Williamson.	Wurtz.	Cooke.			
Aluminum..	..	..	..	..	13'69	13'70	13'7	171'0	13'75	13'75	27'5	27'0	27'40
Antimony ..	..	..	..	..	129'03	12'20	129'0	1504'0	122'00	120'30	122'0	122'0	122'00
Arsenic ..	..	..	..	..	76'00	75'00	75'2	940'0	75'00	75'00	75'0	75'0	75'00
Barium ..	..	..	..	..	68'64	68'50	68'6	857'0	68'60	68'60	137'0	137'0	137'00
Bismuth ..	..	..	..	..	70'95	210'30	106'4	2600'0	208'00	210'00	210'0	210'0	210'00
Boron..	..	..	..	..	10'90	10'90	10'8	136'2	11'00	11'00	11'0	11'0	11'00
Bromine ..	..	..	..	..	78'26	80'00	78'4	1000'0	80'00	80'00	80'0	80'0	80'00
Cadmium ..	..	..	..	..	55'74	56'00	55'8	696'8	56'00	56'00	112'0	112'0	112'00
Cæsium ..	..	..	..	..	—	—	—	—	133'00	—	133'0	—	133'00
Calcium ..	..	..	..	..	20'00	20'00	20'5	250'0	20'00	20'00	40'0	40'0	40'00
Carbon ..	..	..	..	..	6'00	6'00	6'0	75'0	6'00	12'00	12'0	12'0	12'00
Cerium ..	..	..	..	..	46'00	46'00	46'3	575'0	—	46'00	92'0	—	92'00
Chlorine ..	..	..	..	..	35'50	35'50	35'4	443'3	35'46	35'50	35'5	35'5	35'50
Chromium..	..	..	..	..	28'15	26'30	28'1	329'0	26'24	26'20	52'5	53'5	52'20
Cobalt ..	..	..	..	..	29'52	29'50	29'6	375'0	29'50	29'50	58'5	59'0	58'80
Columbium ..	..	..	..	..	—	48'80	—	611'0	—	97'60	195'0	—	94'00
Copper ..	..	..	..	..	31'66	31'70	31'8	396'6	31'70	31'70	63'5	63'5	63'40
Didymium..	..	..	..	..	49'60	48'00	—	—	—	48'00	96'0	—	95'00
Erbium ..	..	..	..	..	—	—	—	—	—	—	—	—	112'60
Fluorine ..	..	..	..	..	18'70	19'00	18'7	237'5	19'00	19'00	19'0	19'0	19'00
Glucinum ..	..	..	..	..	26'50	4'70	17'7	86'5	—	4'70	9'0	—	9'30
Gold ..	..	..	..	..	98'33	196'60	199'0	2458'0	196'00	196'00	196'0	197'0	197'00
Hydrogen ..	..	..	..	..	1'00	1'00	1'0	12'5	1'00	1'00	1'0	1'0	1'00
Indium ..	..	..	..	..	—	—	—	—	—	—	74'0	—	72'00
Iodine ..	..	..	..	..	126'36	127'00	126'0	1586'0	—	127'00	127'0	127'0	127'00
Iridium ..	..	..	..	..	98'68	98'60	98'7	1232'0	127'00	98'60	197'0	198'0	196'00
Iron ..	..	..	..	..	28'00	28'00	27'2	350'0	—	28'00	56'0	56'0	56'00
Lanthanum ..	..	..	..	..	48'00	46'00	36'1	580'0	28'00	46'00	92'0	—	93'60
Lead ..	..	..	..	..	103'56	103'60	103'8	1294'6	—	103'60	207'0	207'0	207'00
Lithium ..	..	..	..	..	6'43	7'00	6'4	82'5	103'50	67'00	7'0	7'0	7'00
Magnesium ..	..	..	..	..	12'67	12'16	12'7	150'0	12'00	12'00	24'0	24'0	24'00
Manganese ..	..	..	..	..	27'67	27'50	27'6	337'5	27'50	27'60	55'0	55'0	55'00
Mercury ..	..	..	..	..	100'07	100'00	101'4	1250'0	100'00	100'00	200'0	200'0	200'00
Molybdenum ..	..	..	..	..	47'88	48'00	48'0	575'0	46'00	46'00	96'0	96'0	96'00
Nickel ..	..	..	..	..	29'57	29'50	29'6	362'5	29'50	29'00	58'5	59'0	58'80
Nitrogen ..	..	..	..	..	14'00	14'00	14'0	175'0	14'00	14'00	14'0	14'0	14'00
Osmium ..	..	..	..	..	99'56	99'40	99'6	1250'0	—	100'00	199'0	199'2	199'20
Oxygen ..	..	..	..	..	8'00	8'00	8'0	100'0	8'00	16'00	16'0	16'0	16'00
Palladium ..	..	..	..	..	53'27	53'20	53'4	664'0	53'00	53'00	106'5	106'6	106'60
Phosphorus ..	..	..	..	..	32'02	31'00	31'4	387'5	31'00	31'00	31'0	31'0	31'00
Platinum ..	..	..	..	..	98'68	98'60	98'7	1237'5	98'94	99'00	197'0	197'5	197'40
Potassium ..	..	..	..	..	39'00	39'00	39'2	489'0	39'11	39'00	39'0	39'1	39'10
Rhodium ..	..	..	..	..	52'11	53'20	52'1	650'0	—	52'00	104'0	104'4	104'40
Rubidium ..	..	..	..	..	—	—	—	—	85'40	—	85'0	—	85'40
Ruthenium ..	..	..	..	..	52'11	53'00	51'7	650'0	—	52'00	104'0	104'4	104'40
Selenium ..	..	..	..	..	39'57	39'70	40'0	495'3	39'50	79'00	79'5	79'5	79'40
Silicon ..	..	..	..	..	21'35	14'00	14'8	185'0	14'00	28'00	28'0	28'0	28'00
Silver ..	..	..	..	..	108'00	108'00	108'1	1350'0	107'97	108'00	108'0	108'0	108'00
Sodium ..	..	..	..	..	22'97	23'00	23'2	287'5	23'00	23'00	23'0	23'0	23'00
Strontium ..	..	..	..	..	43'84	43'80	44'0	548'0	43'75	43'80	87'5	87'5	87'60
Sulphur ..	..	..	..	..	16'00	16'00	16'0	200'0	16'00	32'00	32'0	32'0	32'00
Tantalum ..	..	..	..	..	92'30	68'80	185'0	860'0	—	37'60	138'0	—	182'00
Tellurium ..	..	..	..	..	66'14	64'50	64'0	802'0	—	128'00	—	129'0	128'00
Terbium ..	..	..	..	..	—	—	—	—	—	—	—	—	—
Thallium ..	..	..	..	..	—	—	—	—	203'00	—	203'0	—	204'00
Thorium ..	..	..	..	..	59'59	59'50	59'6	744'0	—	59'50	238'0	—	231'40
Tin ..	..	..	..	..	58'82	59'00	59'0	735'3	59'00	116'00	118'0	118'0	118'00
Titanium ..	..	..	..	..	24'29	25'00	24'5	300'0	25'00	50'00	50'0	50'0	50'00
Tungsten ..	..	..	..	..	94'64	92'00	95'0	1150'0	—	92'00	184'0	184'0	184'00
Uranium ..	..	..	..	..	60'00	60'00	217'0	743'0	59'40	60'00	120'0	120'0	120'00
Vanadium ..	..	..	..	..	68'55	68'50	68'6	856'8	—	68'50	137'0	68'6	51'37
Yttrium ..	..	..	..	..	32'20	—	32'2	437'5	—	—	64'0	—	61'70
Zinc ..	..	..	..	..	32'52	32'60	32'2	406'6	32'53	32'50	65'0	65'2	65'20
Zirconium ..	..	..	..	..	33'62	33'60	22'4	558'5	—	33'50	89'5	89'6	89'60

\* Communicated by the Editors of the *Journal of the Franklin Institute*. From advance-sheets.



# ON A METHOD FOR THE DETERMINATION OF SULPHUR IN COAL GAS.\*

By A. VERNON HARCOURT, M.A., F.R.S., Sec. C.S.

THE apparatus on the table represents the result of a number of experiments on the determination of sulphur in coal gas, and provides, I believe, a means of making this determination easily and accurately.

But since its completion a new method of determining sulphur has been published and brought into use by the gas referees, and as this method is certainly superior in simplicity, and may be superior in other respects to that which I have devised, I feel some hesitation in laying any claim to the attention of the Section. However, the problem to be solved is one of so much difficulty and so much importance, that I will venture to describe very briefly the process which is here in operation.

Some difference of opinion exists as to the statement of the problem. Do we desire to know the total amount of sulphur in the gas analysed, or the amount which is converted into sulphur acids when a jet of gas is burned in the air? On the one hand, the practical object being to ascertain the injury to which we are liable from gas burned in the ordinary way, and the only sulphur compounds formed by burning gas, which are known to be injurious, being the sulphur acids, a method in which the acids formed by a jet of gas burning in the air are determined appears the most appropriate. On the other hand, we can hardly expect to arrive at definite and concordant results, except by determining the total amount of sulphur, since the part, if any, that commonly escapes unburnt, is likely to vary with the burner employed. I believe, however, that it will be found that this distinction is not a very real one, but that in a jet of gas which is well supplied with air,  $\frac{9.9}{100}$ ths of the sulphur is oxidised.

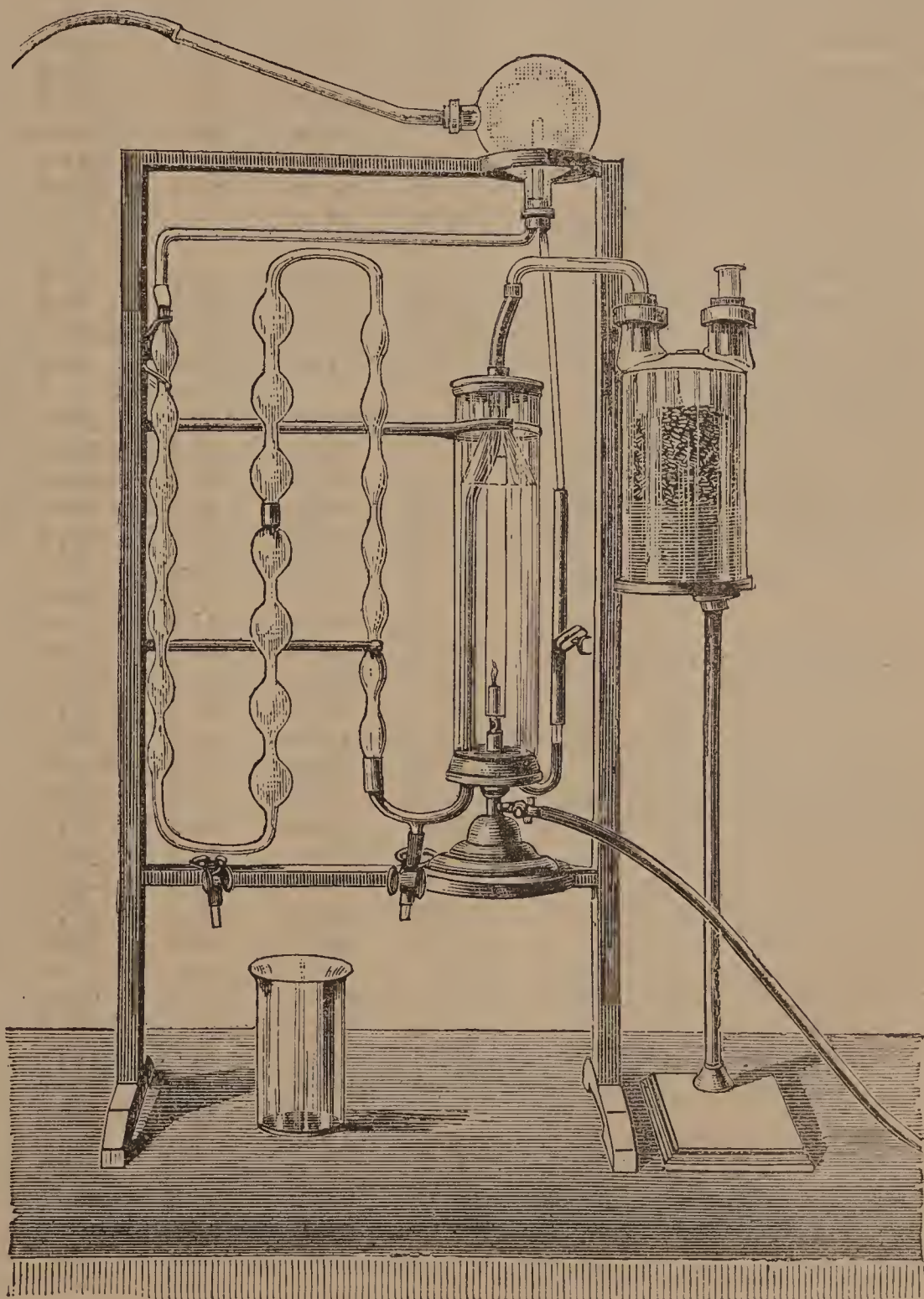
In my apparatus I use a small Bunsen's burner, which gives a flame, scarcely visible in the daylight, of three-quarters of an inch in length when burning at the rate of a quarter of a cubic foot per hour. The gas is supplied by means of an aspirator with between 20 and 30 times its volume of air. A funnel placed at the top of the cylinder in which the gas burns admits the air through holes in its neck and distributes it down the sides of the cylinder, while the products of combustion and the excess of heated air are withdrawn from within the funnel through a tube rising from the bottom of the cylinder. This tube fits loosely into another tube, which passes through an india-rubber plug closing the cylinder, and is attached to a system of bulbs, through which are driven the air in which the gas has burned, and the liquid used to wash it. From the bulbs they pass into a two-necked receiver placed over the cylinder, whence the air escapes into the aspirator, while the liquid descends through a small tube to the bottom of the cylinder and repeats its course.

The liquid is an ammoniacal solution of copper. The ammonia serves, as is well known, to aid in fixing the sulphur compounds, while the copper determines, in presence of the excess of air, the oxidation of sulphite to sulphate. The activity of copper in this respect may readily be proved by pouring into each of two large bottles a few drops of

ammonia and of sulphurous acid, and adding, in one case, a drop of a solution of any copper salt. After shaking both bottles for a minute or two to bring the liquid and air contained in them into contact, if some dilute sulphuric acid is poured into each, and then some solution of iodide, it will be found that in one case plenty of sulphurous acid remains, but that in the other, when the drop of copper solution was added, all has disappeared.

When coal gas burns, the greater part of its sulphur seems to be oxidised completely to sulphuric acid, but a part of it only to sulphurous acid, and it may well happen that some of this sulphurous acid, after being arrested by the ammonia, may be disengaged again by the great excess of carbonic acid by which it is accompanied, and may finally escape from the solution. Once converted into sulphate it is safe.

The air which enters the cylinder has passed first through a large Woolfe's bottle containing pumice and ammoniacal solution of copper, the latter rising three or four



inches from the bottom of the bottle, the former to the top. Before each experiment 50 c.c. of strong ammonia is poured into the bottle. This arrangement serves to keep up the supply of ammonia in the apparatus, and to purify the air from traces of sulphurous acid or sulphuretted hydrogen. To trust to the purity of the air, even in rooms which are not chemical laboratories, appears to be very hazardous, when we consider that the volume passing through the apparatus in each experiment is 50 cubic feet, or more, and that 1-50th of a grain of sulphur

\* Read before the British Association. Reprinted, by permission, from the *Journal of Gaslighting*.



in this volume would be reckoned as an additional grain in 100 cubic feet of the gas.\*

When about 2 cubic feet of gas have been burned the operation is stopped, and the liquid withdrawn through two nipper-taps; a charge of water is sent round the apparatus by the aspirator, and drawn off into the same vessel as the original liquid, the drainage is sufficiently complete for a second washing to be hardly needed. It is convenient to get rid of most of the ammonia and part of the water by evaporation before precipitating with barium chloride.

To test the trustworthiness of the results obtained by this method, I have substituted for the lamp a tube, through which was passed, for as many hours as the process ordinarily occupies, a current of carbonic acid which had bubbled through a very dilute solution of sulphurous acid, whose strength was determined before and after the experiment. It was found that within the limits of error likely to occur in estimating the strength of the solution of sulphurous acid, the weight of sulphate of baryta obtained corresponded to the sulphurous acid which had passed out of the solution. It was in making these experiments that my attention was forcibly directed to the need of purifying the air, for I found at first that more sulphate of baryta was precipitated than the sulphurous acid could furnish. The air had passed through a bottle containing pumice and permanganate of potash, but the contents of the bottle had become dry, and, therefore, inoperative. In subsequent experiments the air was more efficiently purified, and the weight of sulphate of baryta was no longer in excess.

The completeness of the washing effected in the apparatus has also been tested by interposing a second set of bulbs, with a charge of ammoniacal solution of copper, between the aspirator and the apparatus. The liquid from these bulbs has always yielded a trace, but a mere trace, of sulphate of baryta.

Lastly, I have made a number of simultaneous determinations of the same sample of coal gas.

I will give the results of four pairs of determinations of samples of gas supplied by the Oxford Gas Company, made on consecutive days:—

	Sample	A	B	C	D
Grains of sulphur in 100 cubic feet.	1.	21.0	19.9	20.1	20.8
	2.	21.4	20.0	20.3	20.5

Since completing this apparatus I have made some experiments with a view to a more complete purification of coal gas from sulphur. Two pairs of analyses of the purified gas gave the following numbers:—

	Sample	A	B
Grains of sulphur in 100 cubic feet.	1.	4.54	4.49
	2.	4.57	4.54

## PROCEEDINGS OF SOCIETIES.

### CHEMICAL SOCIETY.

Thursday, December 15th, 1870.

Professor FRANKLAND, F.R.S., Vice-President, in the Chair.

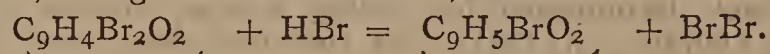
The following gentlemen were elected Fellows:—P. T. Atkinson, R. Koma, J. F. Stark.

Mr. PERKIN, F.R.S., read a paper "*On Some New Derivatives of Coumarin.*" The author succeeded in obtaining the following new bodies:—

\* Dr. Angus Smith has found the amount of sulphurous acid in Manchester air to attain sometimes as much as 1-1000th per cent. Such air admitted without purification would affect a sulphur test to the extent of 16 grains in 100 cubic feet of gas.

Dibromide of coumarin	..	$C_9H_6O_2Br_2$
Dichloride of coumarin	..	$C_9H_6O_2Cl_2$
$\alpha$ Bromocoumarin	..	$C_9H_5BrO_2$
$\beta$ Bromocoumarin	..	$C_9H_5BrO_2$
$\alpha$ Chlorocoumarin	..	$C_9H_5ClO_2$
$\beta$ Chlorocoumarin	..	$C_9H_5ClO_2$
$\alpha$ Dibromocoumarin	..	$C_9H_5Br_2O_2$
$\beta$ Dibromocoumarin	..	$C_9H_5Br_2O_2$
Tetrachlorocoumarin	..	$C_9H_2Cl_4O_2$
Coumarilic acid	..	$C_9H_6O_3$
Bromocoumarilic acid	..	$C_9H_5BrO_3$
Sulphocoumarilic acid	..	$C_9H_6O_2SO_3$
Disulphocoumarilic acid	..	$C_9H_6O_2 \cdot 2SO_3$

*Dibromide of Coumarin.*—A solution of coumarin in carbon disulphide is mixed with a similar solution of bromine, and the mixture, after leaving it to stand for twelve hours, allowed to evaporate spontaneously. When dibromide of coumarin is treated with an alcoholic solution of potassic iodide, it becomes brown, and on evaporation deposits needles, apparently consisting of a mixture of iodine and coumarin crystals,  $\alpha$  bromocoumarin. By heating two parts of bromine with one part of coumarin (both dissolved in carbon disulphide) in a sealed tube for three or four hours to about 200° C., monobromocoumarin is obtained. In this reaction dibromocoumarin is undoubtedly first produced, but at the high temperature employed it is decomposed by the hydrobromic acid produced, losing half of its bromine, thus:—

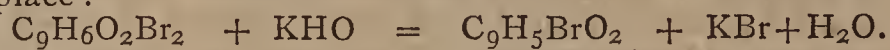


Dibromocoumarin.

Bromocoumarin.

The bromocoumarin obtained by this process sometimes crystallises from alcohol in long slender needles. These, however, on standing in the mother-liquor for a few days become short and hard, like those described in a previous paper.

However, a still more simple process for the preparation of bromocoumarin is to decompose the dibromide of coumarin with alkalis, the following reaction taking place:—



Dibromide of  
coumarin.

Bromocoumarin.

From the difference in the appearance of the products obtained by the two processes, Mr. Perkin was at first inclined to think they were isomeric forms of bromocoumarin; but as the fusing points are nearly identical, as are also the products of decomposition, these variations must be ascribed to the presence of small amounts of impurities.

$\alpha$  Bromocoumarin, when left in contact with cold alcoholic ammonia, decomposes with formation of ammoniac bromide, and a non-crystalline sticky mass, easily soluble in water. Heated with potassic hydrate it yields potassic bromide and a new acid.

It decomposes when heated with potassic cyanide and alcohol in a sealed tube, forming a brown solution, from which water throws down a drab-coloured amorphous precipitate.

When heated to 200° C. in a sealed tube for five or six hours, slight decomposition takes place, with formation of hydrobromic acid. A similar change takes place if water be used instead of alcohol.

$\alpha$  Dibromocoumarin.—On a previous occasion, Mr. Perkin prepared this body by heating in a sealed tube to 140° C., a mixture of one part of coumarin, two parts of bromine, and four or five parts of disulphide of carbon. He afterwards found, however, that this process is greatly improved by the addition of iodine to the mixture, as it is then only necessary to heat the sealed tube for four or five hours in a bath of salt and water to complete the reaction.

The product is then freed from disulphide of carbon by evaporation, and from iodine by means of potassic iodide, and finally purified by two or three crystallisations from alcohol.



The fusing-point of this substance is  $183^{\circ}\text{C}$ ., and not  $174^{\circ}\text{C}$ ., as has been previously given.

*$\beta$  Bromocoumarin.*—It will be remembered that the sodium derivative of the hydride of salicyl when digested with acetic anhydride yields ordinary coumarin. It therefore appeared to be of interest to treat the sodium compound of brominated hydride of salicyl in a similar manner to see whether a brominated coumarin could be obtained. This was found to be the case. The hydride of sodium bromo-salicyl when submitted to the action of acetic anhydride, yields a quantity of hydride of bromo-salicyl and a body which, when crystallised from alcohol, yields colourless flat prisms, the analysis of which showed it to be monobromocoumarin,  $\text{C}_9\text{H}_5\text{BrO}_2$ . It greatly differs in properties from the bromocoumarin previously described, its fusing-point being  $160^{\circ}\text{C}$ ., or  $50^{\circ}$  higher, and when boiled with alcoholic or aqueous potassic hydrate, it does not decompose with formation of potassic bromide, but simply dissolves like ordinary coumarin.

*$\beta$  Dibromocoumarin.*—On treating the hydride of sodium di-bromosalicyl with acetic anhydride in exactly the same manner as for the preparation of  $\beta$  bromocoumarin, a beautifully crystalline product is obtained, of the composition  $\text{C}_9\text{H}_4\text{Br}_2\text{O}_2$ .

It is not the same body as that obtained by acting on coumarin with bromine and iodine. It fuses at  $176^{\circ}\text{C}$ ., and is not decomposed by boiling with a solution of potassic hydrate. Mr. Perkin has, therefore, designated it as  $\beta$  dibromocoumarin.

*Dichloride of Coumarin.*—A solution of coumarin in chloroform absorbs chlorine gas, only minute quantities of hydrochloric acid being formed. On allowing the solution to evaporate spontaneously after the chlorine has been passed through it for an hour or two, a syrupy product is obtained very like new honey. This is the dichloride of coumarin. From its products of decomposition there can be no doubt that it possesses the formula  $\text{C}_9\text{H}_6\text{O}_2\text{Cl}_2$ .

On keeping, it appears to decompose, when heated it gives off hydrochloric acid, and when distilled is converted into chlorocoumarin. With alcoholic potash it decomposes in the same way as the dibromide.

*$\alpha$  Chlorocoumarin.*—A mixture of one part of coumarin and three parts of pentachloride of phosphorus, when mixed and heated in a retort placed in an oil-bath, slowly react upon each other as the temperature rises, and when the oil has reached about  $200^{\circ}\text{C}$ ., the product becomes a dark brown liquid. During this reaction a volatile liquid, consisting chiefly of bichloride of phosphorus distils over. The contents of the retort after treatment with water become a pasty mass of crystals, which is first purified by distillation and then by several crystallisations from alcohol. Its analysis gave the formula  $\text{C}_9\text{H}_5\text{ClO}_2$ .

It is very curious that if half the amount of pentachloride of phosphorus mentioned above be employed, the product of the reaction suddenly carbonises—sometimes when the oil-bath is at a temperature as low as  $153^{\circ}\text{C}$ ., whereas, with the excess of pentachloride, it may be heated in an oil-bath standing at  $200^{\circ}\text{C}$ .

*$\alpha$  Chlorocoumarin* may be easily prepared by treating the dichloride coumarin with alcoholic potash in exactly the same manner as described for the preparation of  $\alpha$  bromocoumarin. It fuses at  $122^{\circ}$  to  $123^{\circ}\text{C}$ ., and when heated possesses an agreeable aromatic odour.

*Tetrachlorocoumarin.*—Chlorine gas, when passed through a solution of coumarin and iodine in tetrachloride of carbon, is rapidly absorbed, hydrochloric acid being evolved. If the gas be passed for two or three hours a quantity of a reddish body separates; on evaporating the product so as to separate the tetrachloride of carbon, an oily residue is obtained, the red substance having fused with the impurities. On mixing this with alcohol it soon becomes a white paste. On pressing this in a small linen bag a white product is obtained, which is further purified by being several times crystallised from spirit. The num-

bers of the analysis lead to the formula  $\text{C}_9\text{H}_2\text{Cl}_4\text{O}_2$ . It fuses at  $144^{\circ}$  to  $145^{\circ}\text{C}$ .

*Coumarilic Acid.*— $\alpha$  bromocoumarin, when boiled with a solution of potassic hydrate, decomposes, yielding potassic bromide and the salt of a new acid. To prepare this acid in a pure state it is best to proceed in the following manner. A quantity of pure  $\alpha$  bromocoumarin is mixed with an excess of the ordinary solution of potassic hydrate. On heating this mixture the bromocoumarin gradually dissolves, but on reaching the boiling point the solution rapidly becomes a pasty crystalline mass. Sufficient water is then added to dissolve this, and the boiling continued for about an hour. The solution on cooling deposits the potassic salt of the new acid in small needles. To obtain the acid from this salt it is purified and then dissolved in water, and hydrochloric acid added in excess. The new acid is then thrown down as a snow-white crystalline precipitate, which is purified, first by washing with water on a filter and then by crystallisation from boiling water. Its formula is  $\text{C}_9\text{H}_6\text{O}_3$ , as the following comparisons will show:—

Theory.				Experiment.	
				I.	II.
$\text{C}_9$ .. ..	108	66.67		66.46	66.72
$\text{H}_6$ .. ..	6	3.70		3.86	3.67
$\text{O}_3$ .. ..	48	29.63			
	162	100.00			

This acid, which Mr. Perkin proposes to call coumarilic acid, fuses at  $192^{\circ}$  to  $193^{\circ}\text{C}$ . It distils without leaving any residue, but decomposes partially, with formation of an oily body smelling like naphthalin. When gently heated it sublimes. It is monobasic. Mr. Perkin has prepared its salts of the alkalies and the alkaline earths as well as those of silver, lead, mercury, and iron.

*Bromocoumarilic Acid.*—It is prepared like the above acid, but substituting  $\alpha$  dibromocoumarin for bromocoumarin. It possesses the formula  $\text{C}_9\text{H}_5\text{BrO}_3$ . Its fusing-point is  $250^{\circ}\text{C}$ . It forms, like coumarilic acid, well-defined salts with ammonium, soda, &c.

*Sulphocoumarilic Acid.*—On digesting a mixture of about one part of coumarin and five parts of fuming sulphuric acid in the water-bath for an hour or two, the product will be found to be perfectly soluble in water. This, when diluted and neutralised with baric carbonate, yields, besides baric sulphate, a soluble salt, which, when evaporated, crystallises in tufts of transparent prisms. To obtain the new acid from this salt it is dissolved in water, and sulphuric acid added in exactly the quantity necessary to precipitate all the barium as sulphate. The solution is then filtered and evaporated, first over the water-bath and then *in vacuo*. In this way the acid is usually obtained in needles easily soluble in water.

From the analysis of its salts the formula of sulphocoumarilic acid when anhydrous is  $\text{C}_9\text{H}_6\text{O}_3\text{SO}_3$ .

Mr. Perkin has prepared ammonic, potassic, sodic, baric, and strontic sulphocoumarilates.

*Disulphocoumarilic Acid.*—On heating a mixture of about eight parts of fuming sulphuric acid and one part of coumarin to a temperature of  $150^{\circ}$  or  $160^{\circ}\text{C}$ . for an hour or two, the product will contain two sulpho-acids, viz., sulphocoumarilic acid and disulphocoumarilic acid. On treating this with baric carbonate in the usual manner the solution will contain the barium salts of these two oxides. To separate them the solution is evaporated to dryness, and treated with warm water. This removes the baric sulphocoumarilate, leaving the less soluble salt of the new acid behind. This salt has the formula  $\text{C}_9\text{H}_4\text{O}_2\text{Ba}''2\text{SO}_3$ .

From what has been said of the above chlorine and bromine derivatives, it is evident that the chlorine or bromine must be related to different carbon groups, according as the product belongs to the  $\alpha$  or the  $\beta$  series. In the latter case it is contained in the  $\text{C}_6$  group as these bodies are produced from the brominated hydride of

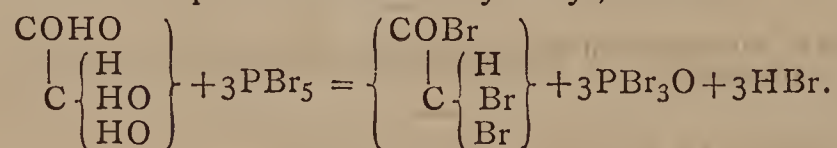


salicyl. The bromine in the bromocoumarin obtained from these bodies by means of acetic anhydride is not attacked by boiling with potash. In the  $\alpha$  series the Br or Cl must be connected with the carbon of what may be called the acetic residue. The bodies of this series are easily decomposed with alkalies. In  $\alpha$  dibromocoumarin one-half of the Br appears to be in union with the C<sub>6</sub> group, and the other with the acetic residue.  $\alpha$  bromo- and chlorocoumarin, from their yielding with alkalies coumarilic acid, seem to be bromides and chlorides of an acid radicle (coumarilyl). But the ammoniac coumarilate on boiling with potash does not give the acid. It may, therefore, be that coumarilic acid is not a true acid containing the group COHO, but is only coumarin with one of its H replaced by HO.

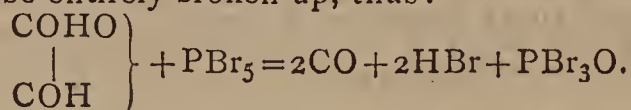
Fittig and others consider coumarin as the glycollide of oxycinnamic acid. If this were the case it certainly would be an anomalous one, as it may be kept dissolved in caustic alkali for months without formation of appreciable quantities of coumaric acid; neither does it form an amide when treated with gaseous ammonia. Whereas, the corresponding glycollide of salicylic acid is converted into a salicylate as quickly as it dissolves in an alkali.

The next communication was by Dr. DEBUS, "On the Formula of Glyoxylic Acid."

Dr. DEBUS showed that this acid ought to be written C<sub>2</sub>H<sub>2</sub>O<sub>3</sub>, and not C<sub>2</sub>H<sub>4</sub>O<sub>4</sub>. He considers it in reality to be the aldehyde of oxalic acid. Among other reasons for this view he quoted its behaviour towards bisulphites. Dr. Odling was of the same opinion. He sees the aldehydic character of glyoxylic acid in its property of easily combining with an atom of water, or of ammonia, or of ethyl, &c. Mr. Perkin thinks the second formula the right one. Among other evidences for the correctness of this view, he mentioned the fact that glyoxylic acid, when treated with phosphoric pentabromide, takes up three atoms of bromine in the place of three of hydroxyl, thus:—



Were glyoxylic acid constituted as represented by Dr. Debus, then, argued Mr. Perkin, there was every reason to believe that when acted upon by phosphoric pentabromide it would be entirely broken up, thus:—



## CORRESPONDENCE.

### MAGNETIC POWER OF A BATTERY.

To the Editor of the Chemical News.

SIR,—In your "Correspondence" of CHEMICAL NEWS, vol. xxii., p. 272, allusion is made to the statement in text-books of electricity that the intensity of the current is greatest when the external resistance is equal to the internal. As a proof is not usually given, the following, which I think will be found satisfactory, may be of use to some of your student-readers. Suppose we have  $m$  cells, the electromotive force of each being  $E$ , and the internal resistance of each being  $R$ . Suppose the cells are so distributed that we have  $x$  rows, each row consisting of  $y$  cells, in each of the rows the positive elements being connected one with another, and also the negative elements being connected one with another. If, then, the external resistance be  $r$ , and the intensity of the current  $I$ , we have, by Ohm's law,—

$$I = \frac{x E}{\frac{x R}{y} + r}$$

Also,  $x y = m$ . Differentiate with respect to  $x$ , and we get—

$$\frac{dI}{dx} = \frac{E r + \frac{x^2}{y^2} \frac{dy}{dx} E R}{\left(\frac{x R}{y} + r\right)^2}$$

For a maximum or minimum value of  $I$ , the condition is—

$$E r + \frac{x^2}{y^2} \frac{dy}{dx} E R = 0$$

Substituting for  $\frac{dy}{dx}$  its value  $-\frac{y}{x}$ , we get as the condition

$$r = \frac{x R}{y}$$

That is, the external resistance is equal to the internal. If we differentiate again, we obtain—

$$\frac{d^2 I}{dx^2} = \frac{E R \left( \frac{x}{y} \frac{dy}{dx} - 1 \right) \left( 3r - \frac{x R}{y} \right)}{\left( \frac{x R}{y} + r \right)^3}$$

Substituting for  $\frac{dy}{dx}$  its value  $-\frac{y}{x}$

$$\frac{d^2 I}{dx^2} = -\frac{2 E R \left( 3r - \frac{x R}{y} \right)}{\left( \frac{x R}{y} + r \right)^3}$$

Suppose, now, that  $\frac{x R}{y} = r$ ; and the expression becomes—

$$\frac{-4 E R r}{\left( \frac{x R}{y} + r \right)^3}$$

That is, when the external resistance is made equal to the internal, the value of  $\frac{d^2 I}{dx^2}$  is negative, which shows that under this condition the value of  $I$  is a maximum.—I am, &c.,

JAMES BOTTOMLEY.

Queenwood College, near Stockbridge,  
Hants, Dec. 8, 1870.

## CHEMICAL PROBLEMS.

To the Editor of the Chemical News.

SIR,—I observe in your review of Professor Thorpe's work on "Chemical Problems" a slight inaccuracy, which I hope you will allow me to point out. You state you "believe that Dr. Roscoe was one of the first to recognise the value of such questions." I, on the contrary, believe that I was the first to introduce them. In 1851 the first edition of my "First Step" appeared, which was the first work, as far as I am aware, devoted to chemical problems, and I had for some years before the publication of it employed the problems in my classes. When I had the work ready for the press I sent a copy of the arithmetical questions to my friend Dr. Frankland, who was then Professor of Chemistry at Owen's College, and he wrote to ask my permission to make use of them in his classes before the work was published, which I readily granted, and he and Dr. Lyon Playfair were the first to employ them after its publication. In my "Second Step," which appeared in 1863, which is prior to the publication of Dr. Roscoe's "Chemistry," I gave an advanced course of chemical problems.

It has been a pleasure to me to see the problems so extensively employed, as I believe they have effected some improvement in chemical examinations, and I hope the new class of questions I have given in the last edition of my "Qualitative Analysis" will be adopted, as I believe they would put a stop to the cramming system, which is



now unfortunately so prevalent, and which is so ruinous to all real mental culture.

But the examinations in practical chemistry are, I think, in a far worse position at the present time than the written examinations, and I think if you would allow an interchange of opinions through the columns of the CHEMICAL NEWS on this subject, it would conduce very much to the progress of the science. I will, with your permission, commence this interchange in another communication.—I am, &c.,

ROBERT GALLOWAY.

Royal College of Science, Dublin,  
December 19, 1870.

## THE REACTION BETWEEN WATER AND NITROGEN TETROXIDE.

To the Editor of the Chemical News.

SIR,—From Mr. Vernon Harcourt's letter, which appeared in the CHEMICAL NEWS, vol. xxii., p. 286., it seems that that gentleman does not raise any objection to the validity of the method of determining nitric oxide employed in my recent investigation.

The exact nature of the chemical changes occurring during the mutual action of water, nitric oxide, and excess of oxygen, was never the subject of any special theory on my part. On the contrary, I accepted all the various equations given in the text-books, and showed that, no matter which be adopted, the ultimate result is the same in all cases, viz., nitric acid.—I am, &c.,

ERNEST T. CHAPMAN.

11, Sutherland Gardens, Harrow Road.  
December 15, 1870.

## ACTION OF ZINC ETHYL.

To the Editor of the Chemical News.

SIR,—In the last number of the CHEMICAL NEWS, I find a short note on the "Action of Zinc Ethyl Upon Phosphuretted Hydrogen," by C. Schultz-Sellack. Allow me to state that, experimenting on the same subject several years ago, Dr. Drechsel and myself found that, contrary to Mr. S.-S.'s statement, zinc phosphine,  $ZnHP$ , or  $Zn_2H_2P_2$ , is readily formed, provided the ethereal solution of the zinc-ethyl be kept cold by a freezing mixture. The zinc phosphine is a perfectly white and amorphous powder, and is converted by the action of iodide of ethyl into Hofmann's well-known double compound of iodide of triethylphosphine and iodide of zinc. We never published the results of our investigation, and I cannot now give analytical data, but our analyses of the zinc phosphine, as well as of the ethylated double compound, agreed perfectly well with the formulæ.—I am, &c.,

B. FINKELSTEIN.

Hebburn, Gateshead-on-Tyne,  
December 17, 1870.

## MISCELLANEOUS.

Letts's Diaries for 1871.—We have received specimens of some of the diaries issued by this well-known firm. The Medical, Monthly, or Professional, and Appointment Diaries are exceedingly well arranged, and contain a large amount of valuable information. They will prove of great service to members of the various professions, &c.

Beer Brewed from Rice.—A. Metz.—It appears that the brewing of beer from rice has already assumed large proportions in some parts of Germany. The author has analysed a variety of this beer brewed at Weisenau, near Mayence, from a mixture of  $\frac{2}{3}$  of malt and  $\frac{1}{3}$  of rice. The beer thus produced is very clear, of a pale colour; the colorimetric test, according to M. Leyser's method, gave

as result that the colour of this beer was equal to that of a mixture of 100 c.c. of water and 1.2 c.c. of decimal normal iodine solution, while the colour of the Munich beers average from 3 to 3.5 and even 4.9 c.c. of the iodine solution alluded to in 100 c.c. of water. The taste of the rice beer is extremely pleasant, very mild; it foamed strongly yet retained its carbonic acid well. Specific gravity = 1.0238. The beer contained, in 100 parts—Alcohol, 3.65; sugar, 1.63; dextrin, 5.13; protein compounds, 0.37; mineral matter, including 0.0775 phosphoric acid, 0.22; loss, 0.01; total quantity of extract, 7.36 per cent, being made up, in 100 parts, of—Sugar, 22.15; dextrin, 69.70; protein compounds, 5.03; ash (including 1.05 of phosphoric acid), 2.99. In order to give a more correct view of the value of this rice beer, as compared with other beers, the author quotes the following average percentage results of analysis of twenty-one varieties of Bavarian beers recently analysed by Dr. C. Prandtl:—

	Rice beer.	Münich beers.		
		Average.	Maximum.	Minimum.
Alcohol .. ..	3.65	3.55	3.98	3.23
Total extract ..	7.36	6.17	6.61	5.42
Sugar .. ..	1.63	1.08	1.38	0.82

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Polytechnisches Journal von Dingler, first number for November, 1870.

This number contains the following original papers and essays relating to chemistry and allied sciences:—

Suggestions for the Construction of a New and Improved Bathometer.—Dr. H. Emsmann.—A bathometer is an instrument for sounding great depths at sea. The details of this paper cannot be well understood without the aid of the engravings which illustrate it.

Estimation of the Total Quantity of Carbon Contained in Iron.—Dr. Wittstein.—The author first states that the method suggested for the estimation of carbon in iron (crude cast-iron) by the late M. Berzelius, is the best and most simple. It consists in treating the iron with chloride of copper. The author's experiments with this method were conducted as follows:—1.25 grms. of coarsely pulverised iron were added to a liquid contained in a flask, and consisting of 50 grms. of water, 10 grms. of chloride of sodium, and 10 grms. of sulphate of copper. The iron was left in this solution for a couple of days. Ten grms. of hydrochloric acid, sp. gr. 1.13, were then added. The flask was next heated on a sand-bath. By this operation the hydrated oxide of iron and the finely divided metallic copper were dissolved, and after the liquid had been diluted with about twice its bulk of water, the carbonaceous matter was collected on a previously weighed filter, and dried at 100°. The quantity obtained weighed 0.097 grm., losing by ignition a quantity of 0.042 grm., which amounts to 3.36 per cent of carbon. The residue of the ignition was tested for the presence of iron and copper by dissolving it in nitro-hydrochloric acid (*aqua regia*). Both metals, to the amount of 1 centigram., were found to be present; the remaining silica was still found to contain a small quantity of carbon.

Testing of Graphite.—F. Stolba.—The author states that the ignition of graphite (previously well dried) may be readily performed in a platinum crucible, the lid of which is perforated with a hole of some 5 m.m. diameter. The lid is placed on the crucible in such a manner as to leave about one-fourth of its opening uncovered; the consequence of this arrangement is that a strong draught of air is caused in the crucible, whereby the combustion of the graphite is greatly accelerated and the combustion completed (supposing 0.5 grm. of substance to have been taken) in about four hours' time over a good Bunsen burner. The introduction of oxygen gas into the crucible is, according to the author, rather a disadvantage, as it often causes the fusion of the ash, and hence the withdrawal of carbonaceous particles from the oxidising action of the gas.

Progress Made in the Desilverising of Lead by Means of Zinc at the Royal Prussian Lead-Silver Smelting Works.—Dr. Wedding and Dr. Bränning.



**Best Method of Extracting Indium from Zinc-blende (native Sulphuret of Zinc).—F. Stolba.**—The author first pulverises the zinc-blende and next mixes that powder with about ro per cent of its weight of burnt gypsum. This mass is made into a paste with water, and formed into round cakes of about three-quarters of an inch thickness, and from four to five inches diameter. Through these cakes holes are bored of about one-sixteenth inch diameter, and one and a-half inches apart. After drying, the cakes are ignited in a strong coal or coke fire; after thorough ignition the material is ground to powder, and treated with hydrochloric or sulphuric acid, and the indium precipitated from the acid solution, while boiling in a copper kettle, by means of zinc.

**Testing for Cæsium as Double Chloride of Tin and Cæsium.—F. Stolba.**—This paper contains an exhaustive account of an analysis of lepidolite from Rozna (Austria). The chief point of interest in reference to the preparation of the double salt alluded to, is that ammonia should be rigorously excluded from the materials, because the ammonium stannochloride is as insoluble in concentrated hydrochloric acid as the cæsium stannochloride.

**Use of Peat as Fuel Mixed with Coals.—Dr. Dingler.**—This Paper treats on the best plan of utilising peat mixed with coal for the purposes of steam-boiler and other furnaces.

**Reduction of Tellurous Oxide by Grape Sugar.—F. Stolba.**—The author, states that when tellurous oxide, dissolved in excess of potassa or soda solution, is heated along with grape sugar. the result is the precipitation of metallic tellurium in finely divided state.

*Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 14, 1870.*

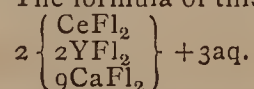
**Nitration of  $\beta$  Naphthol.—O. Wallach and H. Wichelhaus.**—In the introduction to this paper the authors briefly refer to a method of nitration invented by the late Dr. Bolley, and applicable to such bodies as resist the ordinary processes used for this purpose. This new process has been applied by the authors to the nitration of  $\beta$  naphthol previously obtained free from any  $\alpha$  naphthol, the result being the formation of binotronaphthol,  $C_{10}H_5(NO_2)_2(OH)\beta$ . This substance crystallises in small needle-shaped crystals, fuses at  $195^\circ$ , is very difficultly soluble in water even if boiling, but more readily so in alcohol, and very readily in ether and chloroform; these solutions exhibit an intense yellow colour. The  $\beta$  nitro-naphthol does not form salts so readily as the  $\alpha$  compound analogous to it.

**Acetyl Derivatives of Ammonia.—H. Wichelhaus.**—The first portion of this paper contains a lengthy series of complicated formulæ, exhibited for the purpose of showing how triacetamide might be formed. The author next states that he has succeeded in obtaining that body by heating together acetonitrile and acetic acid to a temperature of  $200^\circ$ . The substance thus prepared is a solid, crystalline form, fusing at  $79^\circ$ . The larger portion of this paper is devoted to theoretical discussions on reactions which might be called into play. Triacetamide is neutral in its behaviour with test paper while in solution; diacetamide tinges blue litmus paper red.

**Preliminary Notice.—C. Huber.**—The author states that the body obtained by him some three years ago by the action of bichromate of potassa and sulphuric acid upon nicotine, viz., the acid  $C_6H_5NO_2$ , is not, as has been formerly announced by him, an amido-acid, but pyridine carbonic acid.

**On Nitro-chlorphenol.—T. Petersen.**—This extensive essay, illustrated by several crystallographical diagrams, is divided into the following sections:—Mononitro-monochlorphenol, dinitro-monochlorphenol, trichloronitrophenol, and trichlordinitrophenol.

**On Yttrocrite.—Dr. C. Rammelsberg.**—After briefly referring to the labours of the late Dr. Berzelius on this mineral, which occurs near Fahlun (Sweden), the author states that, having recently analysed this mineral, he found it to consist of, in 100 parts—Lime, 47.27; oxide of cerium, 9.35; yttria, 14.87; loss by ignition, 2.52; the remainder being fluorine. The formula of this substance is—



The specific gravity of this mineral is 3.363.

**On Sulphocarbonylchloride and on a New Chlorosulphide of Carbon, the Perchloride of Methylmercaptan.—B. Rathke.**—The introduction to this essay contains an account of the researches made by Dr. Kolbe, some twenty-five years ago, on this subject. The paper then treats at great length on a series of compounds obtained by submitting to fractional distillation the various substances formed by the action of chlorine upon sulphide of carbon. Four different products of fractional distillation were obtained, viz., (a) a liquid boiling below  $80^\circ$ , which contains, besides unaltered sulphide of carbon, also chloride of carbon and sulphocarbonylchloride, which imparts to this fluid a reddish yellow colour, and a very suffocating odour; this last-named substance could not be obtained in a free state by fractional distillation; (b) at from  $80^\circ$  to  $140^\circ$  a mixture of the substance alluded to under (a), and of another body, came over; (c) at from  $140^\circ$  to  $150^\circ$  large quantities of a yellowish oily liquid was obtained; while, lastly (d), there remained in the retort trichlormethyl sulphon-chloride mixed with the oily body just specified. By carefully instituted distillation the author obtained a liquid boiling at between  $146^\circ$  and  $147^\circ$ , of a golden yellow colour, emitting vapours of hydrochloric acid by exposure to moist air, and depositing sulphur at the same time; this body is perchloride of methyl mercaptan,  $CSCl_4 = CCl_3.SCl$ . The author gives a long description of the various reactions which this body exhibits with different reagents.

**The Law of Avogadro.—A. Naumann,**

*Journal für Praktische Chemie, No. 16, 1870.*

**Concluding Portion of the Essay on the Influence of Temperature upon the Molecular Rotatory Power of some Circularly-Polarising Bodies.—Dr. C. Tuchschnid.**—This memoir is illustrated with six lithographic plates.

**Decomposition of Sulphide of Carbon by Heat.—W. Stein.**—The author relates a series of experiments made with perfectly pure sulphide of carbon. His results show that sulphide of carbon is not decomposed by a very high temperature if charcoal is simultaneously present; it is therefore necessary to keep the retorts plentifully supplied with either charcoal or coke.

**Ether of Sulphon-Acids.—L. Carius.**—In the introduction to this essay, the labours of various authors on this subject are referred to, and ethyl-sulphon-chloride is described. The further portions of this paper treat on:—Ethyl-sulphon-acid ether.—A colourless fluid, insoluble in water, which slowly decomposes it, even at the ordinary temperature of the air; it boils at  $207.5^\circ$ ;  $S(C_2H_5)_2O_3$ ; sp. gr., 1.1508. This substance combines with ammonium, forming ethyl-sulphon-acid-ethyl-ammonium,  $SC_2H_5(NH_3C_2H_5)O_3$ . Ethyl-sulphon-acid-methyl.—A colourless liquid, also decomposed, when in contact with water; boils at about  $200^\circ$ ; formula,  $S(C_2H_5,CH_3)O_3$ . Ethyl-sulphon-acid-amyl.—The author states that he did not prepare this compound; but that a substance formerly prepared by him, and then named sulphurous acid-ethyl-amyl, is, in reality, ethyl-sulphon-acid-amyl.

**Oxamyl-Sulphon Acid (Amyl-Isethionic Acid).—F. A. Falk.**—This memoir treats on amylen-chlorhydrine and products derived therefrom, among which is oxamyl-sulphon-acid,  $C_5H_{10}(HO).SO_2.HO$ , and the salts, it yields with sodium, ammonium, calcium, barium, copper, lead, and silver.

**Isethionic Acid and the Homologous Substances thereof.—L. Carius.**—A critical review of a work lately published in Germany under the above title, by Dr. E. Schwarz.

**Specific Gravity and Expansion of the Ethyl-Sulphon-Acid Ether.—L. Carius.**—The first portion of a lengthy memoir illustrated with woodcuts, and containing a series of tabulated forms exhibiting the results of experiments and analysis.

## NOTES AND QUERIES.

**Manufacture of Kelp.**—Can any reader give me the name of any book on kelp manufacture, and the manufacture of bromine and iodine? I have Richardson and Watts.—A STUDENT.

**Orange-Lead.**—(Reply to J. Dodd).—You will find every information on the subject in Gentele's "Lehrbuch der Farben Fabrikation," a work which you can inspect at the library of the Commissioners of Patents.

**Separation of Tarry Matter from Gas-Water.**—(Reply to "Gas Engineer").—Perhaps you might apply filtration of the liquid through a layer of previously well washed pebbles placed in layers of varying thickness and the largest size on the top.

**Separation of Tarry Matter from Gas-Water.**—The simplest way to separate light tar from gas water is to bring it intimately in contact with heavy tar, and afterwards let settle for a few hours. This will remove the mechanically mixed tar, but not that which is chemically dissolved.—JAMES DONALD.

**Aniline Colours.**—Can any of your readers inform me of the best and cheapest method for precipitating the aniline colours in the form of lakes for the use of paper stainers. According to Perkin's lecture, in the CHEMICAL NEWS, alumina is used along with tannin: I wish to know in what state the alumina is added, also the tannin, and if there are no other earthy substances that will answer the purpose as well as alumina.—STAINER.

## MEETINGS FOR THE WEEK.

TUESDAY, THURSDAY, and SATURDAY, at 3 p.m. each day. Royal Institution. Juvenile Lectures on "Burning, and Unburning." By Professor Odling.

## TO CORRESPONDENTS.

\*\*\* Our Publisher requests us to remind Subscribers that, if their Subscriptions for the ensuing year are sent to him in advance, the amount for one year will be 18s., no postage being charged; but if accounts are sent from the Office, the subscription will be £1.

**China.**—Richardson and Watts's "Chemical Technology," will give you full information on the subject. You will also find particulars in "Traité des Matières Colorantes," &c., par M. P. Schützenberger; vol. i., p. 365.

**W. R.**—We have never seen the statement you allude to.

**S. E. Phillips.**—The formula was an exact copy of the original.

**Robinson, Brothers.**—(1). If you write to Messrs. Gehe and Co., Dresden, they will probably send you their lists. (2). Messrs. Trübner have published a dictionary which would meet your requirements.

**G. Hay.**—This correspondent writes to say that in the tenth line of his letter of last week, he used the words "mixed acids" instead of "dilute acid."



# THE CHEMICAL NEWS.

VOL. XXII. No. 579.

## ON A POSSIBLE SOURCE OF ERROR IN PENNY'S PROCESS FOR THE VOLUMETRIC ESTIMATION OF IRON.

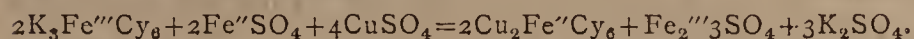
By J. SPEAR PARKER.

HAVING occasion to determine the excess of oxygen in an oxide of manganese combined with a considerable amount of cupric oxide, I endeavoured to do so by dissolving a portion in the solution of a known quantity of iron in hydrochloric acid, afterwards attempting to determine the iron remaining in the state of ferrous chloride by titration with a standard solution of potassic dichromate.

On approaching the termination of the reaction I was surprised to observe the well-known brown colour of cupric ferrocyanide when tested as usual by addition to drops of a weak solution of potassic ferricyanide, thus rendering it impossible to obtain an accurate estimation.

This reaction was evidently owing to the formation of ferrocyanide by the small quantity of ferrous salt present, and consequent precipitation of the copper.

This proved to be the case, for, on dissolving some cupric sulphate, together with about one-fourth its weight of ferrous sulphate, and then adding a solution of potassic ferricyanide, the cupric ferrocyanide was precipitated as before. Its identity was readily proved, for on treating the washed precipitate with potassic hydrate, immediate decomposition ensued, the blue cupric hydrate being produced, altering to the black oxide on boiling. The filtrate was of a pale yellow tint, and after acidification gave, with ferric chloride, a Prussian blue, with ferrous sulphate, a bluish white precipitate. The reaction takes place both in neutral and acid solutions, probably according to the following equation:—



When the amount of copper is small, this brown colouration would not be distinguished from that always produced by ferric salt, and might therefore escape the notice of the analyst, were it not that previous to this the mixture of blue and brown, caused by the presence of a slight excess of ferrous salt, gives a grey or blackish tint, which would at once arouse suspicion. This source of error would seldom occur in practice, being rendered still less probable by the fact that reduction with metallic zinc, which frequently precedes titration, would remove all copper from the solution. Nevertheless, I thought it advisable to place the reaction on record, as I am not aware that it has been previously observed.

## ON APPARENT PARALLELS TO REGELATION.

By CHARLES W. VINCENT.

THE re-solidification of broken ice at temperatures above the freezing point has its parallel phenomena under like circumstances in the cases of many other substances. Some of these are well-known, and at times exceedingly troublesome to workmen in certain manufacturing businesses where rapid liquefaction is a desideratum, but have not, I believe, been noticed in any scientific journal. I note a few instances from my own observation.

(1). *Rosin*.—Good black rosin, free from turpentine, when subjected to pressure in a mould, or otherwise, at ordinary temperatures, becomes completely pulverised, its particles showing no cohesive power whatever (the appara-

tus used was similar to that adopted by Dr. Tyndall for regelation of melting ice).

(2). When the temperature of the mould is raised considerably above the melting-point of rosin, on pressure being applied, a different result ensues; the mass becomes at once solid to the core, the outside alone showing signs of liquefaction.

(3). When rosin has to be melted for manufacturing purposes, if even for a few minutes only the workman neglects to stir, the whole mass becomes completely solidified, and the liquefaction is only carried on at the exterior of the mass, which, when pounded by his stirrer, breaks up without giving the slightest preference to the previous lines of fracture.

(4). The phenomenon is best seen when the temperature of the pan is sufficiently high to melt the outside of the rosin before it has had time to be warmed through.

(5). Pitch, at melting temperatures, gives the same result as rosin, but becomes viscid so much sooner, that though coagulation is readily affected, yet the perfect junction of the broken pieces into a solid mass is not so readily obtainable.

(6). The gums used in the manufacture of varnishes, such as dammar, copal, anime, shellac, &c., give similar results. Whilst being run down at high temperatures, they settle together and cohere (if their surfaces be clean) without the possibility of again separating them in the same places; and this while the exterior of the mass is rapidly melting into liquid of almost the fluidity of oil.

(7). If the temperature of the pan in which any of these viscid substances is being melted be advanced by slow degrees to the point of their real fluidity, the viscosity interferes with the perfect manifestation of the previous results noted—but the aggregating force is still shown—for the separate pieces of rosin, gum, or such like substance, take the same degree of viscosity, and combine into one homogeneous mass, whilst the more rapid melting goes on on the outside of the whole.

(8). From these instances I am inclined to infer that the disintegration caused by liquefaction of one part of these bodies causes them to exert a greater power of aggregation in the parts less exposed to heat.

Royal Institution, December 28, 1870.

## ON THE EXAMINATION OF THE BESSEMER FLAME WITH COLOURED GLASSES AND WITH THE SPECTROSCOPE.\*

By J. M. SILLIMAN, M.E.,

Adj. Professor of Metallurgy, Lafayette College, Easton, Pa.

### I. Examination with Coloured Glasses.

IN the Bessemer process, the progress of the decarbonisation is determined chiefly by the appearance of the smoke, flame, and sparks which are emitted from the apparatus. Owing to the rapidity with which the reactions take place, it is highly important to catch the exact moment when the blast should be turned off. This is indicated by the colour and brightness of the stream of gas issuing from the converter, and by this the moment of total decarbonisation can generally be accurately determined by the naked eye. When, however, pig-iron of certain qualities is used (manganiferous iron, for example) this determination is very difficult; even those who have had much experience make frequent mistakes and find it impossible to produce the same quality of steel at every blow.

In order to intensify these flame-indications, use has been made of the spectroscope, and also of various combinations of coloured glasses. The former was first

\* Read at the Troy Meeting of the American Association for the Advancement of Science.



attempted by Dr. Roscoe, and the latter by Mr. Rowan at the Atlas Works.

Mr. Rowan experimented with a great variety of coloured glasses, and obtained the best results by using three glasses, two of ultramarine-blue and one of dark yellow. This little instrument, or chromopyrometer, as he terms it, is now in daily use at the Atlas Works, its indications being so marked and unmistakable as to render its use safe in the most inexperienced hands.

The following experiments were made at the Bessemer Steel Works of John A. Griswold and Co., in Troy, while pursuing the chemical course in the Winslow Laboratory of the Rensselaer Polytechnic Institute. In my observations on the flame I made use of the spectro-scope, and also of a combination of coloured glasses. This combination consisted of two light yellow glasses and a blue one, through which the sunlight appeared of a deep purplish-blue tint; and as it differed slightly from Rowan's, it gave somewhat different results.

In order to reproduce the appearance of the flame at the different stages of the process, I prepared a plate consisting of about a hundred varieties of colours and tints, all of which were numbered and thus referred to a table which indicated their composition. They were also arranged to be seen with either a light or dark background. The use of this plate was of necessity limited to daylight, but the illustration and description are given as occurring at night in order to show its illuminating power.

At the beginning of the process that which issues from the converter does not appear to be a true flame, but only an illumined stream of gas carrying with it innumerable red-hot pellets of iron. This gas has scarcely any illuminating power, extends but for a short distance from the mouth of the converter, and is sometimes sheathed with a whitish smoke. Seen through the glasses, the flame and sparks have a deep crimson colour, the converter is invisible, and at the base of the flame is a crimson band which continues throughout the process.

As the reaction continues, this stream of gas grows brighter and more elongated, and, after a few minutes a small pointed whitish flame appears, which suddenly increases in size. At this instant the blast-pressure falls from 20 to 18 pounds.

When viewed through the glasses, the upper part of the converter comes dimly into view, and the flame and pellets of iron appear of a lighter colour, while the fragments of slag which begin to be thrown out are of a deep red. This difference in shade between the iron and slag thrown out is, probably, entirely owing to the lower temperature of the latter, for the reason that while the iron is discharged from the metallic bath the slag is washed up on the sides of the converter, and can be seen clinging around its mouth in a spongy mass until detached and thrown out by the blast. The greater porosity of the slag and its consequent more rapid cooling would also cause a difference of temperature.

In the second period the discharge of slag increases, and the flame is very bright and illuminating, with occasional dark streaks. Through the glasses at the beginning of this period the flame is of an ashy blue colour with streaks and flashes of crimson, the edges being sometimes of a purplish hue. At this point surrounding objects are illuminated, and the converter becomes distinctly visible. A wreath of crimson is seen surrounding the flame where it strikes the chimney. By the middle of this period the crimson almost entirely disappears from the body of the flame, leaving only a slight cone at its base, and a border of greenish hue makes its appearance, and gradually grows more decided. Streaks of a dark blue colour are also seen in the body of the flame.

The beginning of the third period is scarcely indicated to the naked eye, though the flame becomes somewhat weakened, and after a few minutes shows dark streaks running through it. Through the glasses at the commencement of this period the rose-coloured cone begins to expand and deepen, the greenish sheath is more decided,

while streaks of dark and green are visible. After a few minutes the change becomes very rapid, a few seconds only being required to reduce the flame from rose-colour to the deep crimson non-illuminating gas, as at first, and again, the converter is lost to view, by which time the blast should have been turned off.

The gradual fading of the crimson from the beginning of the blow and its deepening at the termination of the process, as well as the crimson band at the base of the flame and the wreath of crimson surrounding the flame at the chimney, tend to confirm Mr. Rowan's views, which are, that the different shades of crimson are due to changes of temperature. The stream of gas which comes from the mouth of the converter at the beginning of the process, being illumined from within, derives its colour from the metallic bath, the temperature of which, owing to the combustion of silicon, increases more rapidly during this period than at any other.

The crimson band at the base of the flame, and the wreath of crimson at the chimney might also be accounted for by this theory. The flame rushing from the mouth of the converter has a tendency to create a vacuum at its base around the converter's edge, and thus to cause a wreath of flame to pass over this surface, and by consequent cooling produce the crimson band. The wreath of crimson at the chimney may be also due to the cooling of the flame consequent upon deflection.

It is true we have a seeming contradiction to this theory in the rose-coloured cone extending from the base at the centre, which we would naturally consider the hottest part of the flame; but, as in the flame of the Bunsen burner, the hottest part is in its outer sheath, the conditions of combustion in both being similar, it is probable that that part of the flame occupied by the cone is at a lower temperature than that surrounding it.

The green streaks in the flame are most intense when the manganese spectrum is brightest; and as the colour of the flame when the spiegeleisen is added is also green, we are led to suppose them due to the presence of manganese.

On two occasions simultaneous observations were made with the spectro-scope and the coloured glasses; but with the exception of that just mentioned, and the changes at the commencement and termination of the blow, no striking coincidence was noticed.

(To be continued).

## ON THE EXTRACTION OF THE POISONOUS PRINCIPLE OF THE TUTU PLANT (*CORIARIA RUSCIFOLIA*).

By W. SKEY,

Analyst to the Geological Survey of New Zealand.

A GREAT many experiments have, from time to time, been made upon the Tutu plant, with the object of extracting the formidable poison known by sad experience to exist therein; but, as is well known, these attempts have been always unsuccessful, and have, besides, completely failed to discover anything at all definite as to the chemical or physical character of the poison.

Among these experiments is a series I made while connected with the Geological Survey Department of Otago, a notice of which appeared in the "Juror's Report for the New Zealand Exhibition of 1865," the only result, however, being to prepare the way for future inquiry, which was promised at the time.

The Tutu plant does not grow in the neighbourhood of Wellington in any quantity, hence I have been greatly delayed in fulfilling my promise, much against my will; but recently a large quantity of the seed of this plant has been kindly presented to the Survey, for this particular purpose, by Mr. H. H. Travers, and upon this I at once commenced operations.



The plan I adopted was to separate, as well as I could, all the more immediate proximate constituents of the seed (in which the poison is known to exist), and to test each likely one by itself, in its effects upon the animal economy.

First, I extracted a portion of the finely-ground seed with cold water, and another portion with weakly acidified water, and treated them separately by a new process, now much in vogue, for the separation of alkaloids (Rogers and Girwood), all the evaporations being conducted at a temperature not exceeding 90° F.

The residuum from these processes was very small, and gave no indications of the presence of alkaloids to the proper tests; it consisted almost wholly of gummy matters.

The result seemed to dispose of all that was soluble in water or weak acids, and, to a certain extent, impugned the correctness of the general idea that this poison is of the nature of an alkaloid.

The part of the seed insoluble in these reagents was next examined.

Alcohol was passed through this repeatedly, and the extract evaporated, when a large quantity of a greenish-red coloured substance discovered itself. This, treated with ether, separated into two parts, one a green-coloured oil, soluble therein, the other a resinous substance quite insoluble in this menstruum.

The resinoid substance was reserved for after-examination, and the oil at once tested in regard to its effects on the animal economy.

For this purpose I administered about five minims of it to a full-grown cat, after a twelve-hours' fast; the oil acted as an emetic in a short time, and the greater portion of it was vomited. In half-an-hour, however, the animal showed signs of uneasiness, and convulsive twitches of the ears and eyes, together with a forward jerking of the head, took place, also much frothing of the mouth, culminating in a convulsive fit, in about one hour after the dose was administered. After a little while this fit passed off, only the twitches and forward jerkings continuing; but a second very severe fit, of short duration, occurred in about one hour afterwards, after which the cat gradually rallied. These symptoms agreed generally with those exhibited by cattle and sheep, when poisoned by this plant.

Although I have made but one experiment, I think it will be allowed that the result of this has fairly proved that the poison of the seed, and so, by a very proper inference, the poison of the plant generally, since I find an oily substance throughout it, exists in this oil, if it is not the oil itself. It therefore now only remains to be ascertained whether this oil is a single proximate substance or a mixture or compound of such, and if the latter, which is, or which are, the active ones concerned in the production of these phenomena I have described. Unfortunately, I had not sufficient of the oil to allow me to test this properly, but I am in hopes of having it shortly, as I have been promised a large quantity of these seeds from Taranaki.

The following are the characteristics of this oil, as ascertained up to the present time.

Somewhat viscid at common temperature, but flowing freely at a little above this; colour, pale-green; reaction, acid; taste, bland; burns away readily with much flame; scarcely volatile without decomposition; soluble in ether, alcohol, chloroform, and strong acetic acid; insoluble in hydrochloric or nitric acid; also insoluble in water; does not dry when long exposed to the air.

When boiled with solutions of the caustic alkalis there is much frothing, but only a portion of the oil dissolves, even when the boiling is continued for many hours; the portion dissolved was found to be saponified. The whole of the oil is, however, soluble in a cold alcoholic solution of potash, without yielding a precipitate when admixed with water; hence it is probable that all the acid portion of the oil is really saponifiable, that which was

unsaponifiable, in the first instance, being a product of the metamorphosis of a portion of the normal oil by the process employed.

When the oil is heated to the decomposing point, a substance is given off having the pungent odour of acrolein, a substance characteristic of the presence of glycerine, or oxide of lipyle, the base of common fatty bodies.

Heated with caustic alkalis, either in the wet or the dry way, there are no alkaline vapours evolved, but in the latter case an odorous oil forms, probably cœnanthylid acid.

From the reaction of this oil, here described, it evidently belongs to the series of non-drying fixed oils; in its solubility in alcohol or acetic acid it bears a remarkable resemblance to castor-oil, the only other fixed oil which I find to be wholly soluble in acetic acid. Now, castor-oil, it will be remembered, is a very peculiar oil. It does not contain any of the acids of the common oils or fats, but, in place of them, two very singular acids, quite peculiar, I believe, to this variety of oil; hence I conceive that the acid part of this oil of Tutu to be also quite distinct from the ordinary fatty acids; to be in all probability, peculiar to it; and to one or more of these acids I should ascribe the poisonous effects of the oil.

If further experiments should confirm the correctness of the views here stated, this case will, I conceive, become invested with an interest beyond that immediately under our notice, since it will offer another instance in which a non-nitrogenous oily principle is proved to affect the system like a neurotic poison, this class of poisons being almost always alkaloids, or at least nitrogenous substances.

Now it will be remembered there are several poisonous plants in Europe, which have, hitherto, refused to yield any pure poisonous principle to chemical processes, but then these processes have been, as a general rule, I believe, especially for the detection of alkaloids. With this case to point, therefore, it does seem in the highest degree probable that, in some of these cases, at least, the poisonous effects may be due to a non-nitrogenous oil, not yet isolated or examined. In view of this I have recommended the subject for examination to a friend of mine residing in England, so that I expect in a few months to hear something more of this, or else to have selections of seeds, &c., from the plants I have named in my letter, so that I can inquire into this subject myself.\*

With regard to antidotes for administration to animals, &c., poisoned with the Tutu plant, I should be inclined to think that, in addition to emetics and purgatives, very dilute acids would be beneficial, since, by preventing saponification of the oil, they would tend to keep it insoluble, and therefore inert.

As being somewhat related to the subject, I may state that the seed of the Karaka tree (*Corynocarpus laevigata*), which is also of a poisonous nature, has refused, in a similar manner, to yield any alkaloid to my processes, but it gives up an oil to alcohol, which resembles the above in some of its reactions. It seems to exercise a specific effect upon the animal economy when administered in small doses, inducing at first great uneasiness, and afterwards restless, unwilling sleep, with sudden starting. Unfortunately I had not sufficient of it to get any decisive results.

This oil is also soluble in alcohol, acetic acid, ether, and in hydrochloric acid.

It is very bitter, and feebly soluble in water.

In one important respect it differs from the oil of Tutu. It evolves ammonia when boiled with potash, thus, in regard to its composition, allying itself to the alkaloids, though in its reactions apparently distinct.

\* Since this paper was read, I learn from the CHEMICAL NEWS (vol. xx. p. 70) that M. Van Ankum has discovered the poisonous principle of the *Cicuta virosa* to be an essential oil, of formula  $C_{10}H_8$ , but "could not find any alkaloid in this plant at all." This was one of the plants especially selected for examination in the communication alluded to.



## ON FERMENTATION.\*

By Professor A. W. WILLIAMSON, F.R.S.

(Continued from page 305.)

In the composition of alcoholic ferments there are several substances of which we know very little at present, I am sorry to say, but the want of this knowledge is so great that I have no doubt it will be soon supplied. Certainly this is a most important field for the investigation of naturalists who possess an accurate knowledge of chemical manipulation; I mean the simplest and lowest organisms, whose functions are of such importance in these changes, certainly claim much careful investigation. But some of the things which we do know about the yeast cells I must now state, with relation to the facts and ideas which we have just had before us. In the first place, with regard to their growth; it is very common, in the process of brewing, to feed the yeast cells with a substance which is formed in the germination of barley. When barley is left in a moist state, at a suitable temperature, it begins to sprout, and during that process there is a change in two of its constituents, which I showed you the other day. One is gluten, a body containing nitrogen, which I compared, for the sake of convenience, to muscular fibre, being in reality very closely allied thereto in chemical composition, and during the germination of the seed this substance passes over into some product or products—I had better speak quite generally—known by the name of diastase. In the yeast cells there is a substance very nearly resembling in composition that of gluten, and it cannot be doubted that this gluten, or albuminous body as it is frequently called, is capable of undergoing a similar transformation into diastase, and of all foods the yeast cell enjoys most those which contain diastase. I have a good many yeast cells growing in a suitably heated chamber, and those which seem to thrive most are some which were put into an infusion of malt, to which sugar was added. It is common, in the process of fermentation, to put in yeast in tolerable quantity, but the extent to which it grows depends upon the time for which it is left in contact in the material. I am told that the common proportion is about one-twentieth of the quantity of yeast required. For instance, if 20 lbs. of yeast are wanted to effect a given fermentation, you put into the liquid which has been fermented 1 lb. of yeast calculated in the dry state, and give it this diastase to feed upon. At the same time, there is sugar present in the liquid, and during the process of fermentation this pound weight of yeast increases more and more, by a process of true germination and growth. Professor Mitcherlich actually saw, under the microscope, some little cells, of yeast sprout, and put out, from the side of the parent cell, small cells which gradually increased in size. The actual process, however, has not been seen by many observers. And not only does the yeast cell in that way feed upon these albuminous bodies, which are grouped together by the name of diastase, but it also takes part of the sugar; and these are the two prominent facts which we know with regard to its food—that it feeds upon substances of those two classes; sugar, which contains no nitrogen, and also nitrogenous substances, which are formed by the partial breaking-up of the gluten. On the other hand, its decomposition—I mean during its life—I am not speaking of any decomposition which its materials may undergo if it is killed—gives off alcohol, carbonic acid, succinic acid, and glycerine; in fact, the four chief products of ordinary alcoholic fermentation, which I enumerated to you the other day. And while these products are being given off, there is at the same time a considerable quantity of nitrogenous substances being given off. The albuminous matter in the yeast cells is undergoing decomposition, and is giving off nitrogenous substances. There is not any well-authenticated case of the yeast cell forming,

during its active functions, products of complete breaking-up or putrefactive decomposition; all the products which we know best are substances of considerable complexity—less complex than the materials of the plant, but of great complexity; and, accordingly, the notion which Liebig had that the yeast-cell is active in the proportion as its materials are undergoing complete analyses or breakings-up, and forming ammonia and carbonic acid, is not now entertained by that distinguished philosopher.

Some time ago, an exceedingly important experiment was made by M. Pasteur, with a view of testing the vital functions of the yeast cells in a definite way. The statements which I have made to you contain a good many terms which are exceedingly general, as, for instance, the allusions to diastase. We really do not know what that is. We know about what sort of a thing it is made from, but not definitely. And the same with the nitrogenous products which are given off by the yeast cells; we know something about them, but only a little. Pasteur put into a solution of sugar, in which some yeast particles were present, some ammonia combined with an acid, and at the same time he put some of the ashes of other yeast cells. He took a certain quantity of yeast and burnt it, so as to remove by oxidation the carbon, hydrogen, and nitrogen of the substance, and the earth substances which remained, which are essential to the formation of a new yeast cell, he put into some fermenting liquid, together with some salt of ammonia. When he did that, he really was treating the yeast cells very much in the same way as a good farmer treats the wheat plant. If you want a wheat plant to increase rapidly, you must, in the first place, take care to supply to it all that the wheat plant takes up in the shape of mineral matter from the soil, and the best way to find that out is to burn some wheat and see what is left. Then you must supply plenty of ammonia, and the more ammonia you supply up to a certain extent, the more rapidly does the wheat grow, by building up various simple substances into the complex substance, gluten, which I was speaking of just now. Pasteur put into such a mixture a few little cells of the yeast, and they did not thrive. They did transform some sugar into alcohol and carbonic acid, but they evidently were not at home, and at the end of a certain time, I forget how long, he found there was actually a smaller weight of yeast present than he had put in. That was a very different result from what happens when nitrogen is supplied to the yeast plant in the form which I mentioned just now as the usual one; and I think the fact is most instructive, and serves to show us what kind of a being the yeast cell really is—I mean whether it should be classed among animal or vegetable beings. I need hardly say that absolute distinctions amongst beings which we find in nature are out of the question; we do not generally get any absolute line of demarcation, for one class flows over into the other; but still the ideas which serve us to classify organic and other beings are exceedingly important, and in a case like this it is certainly of considerable interest to have some leading idea, by which one may see whether there is a reason for placing these beings amongst vegetable or animal organisms, and we cannot help giving special weight in that respect to the kind of process which the respective classes of beings carry out in their organisms. Plants build up complex substances from simple. All the most complex substances that we can get are made in the organisms of plants. They may have been taken over by animals from plants, but they are formed in the main by plants. And the chief chemical activity of animals is precisely opposite; they take those complex substances and break them down, by means of their vital functions, to the simple products which are exhaled and given off in the processes of animal life. Therefore, the question whether the process which the yeast carries on is a synthetical process—a building up, or whether it is in the main an analytical process, is certainly one of the most important which can guide us. Now, I think what I have said must appear to you all most conclusive in that

\* The Cantor Lectures. Delivered before the Society of Arts.



respect—that what we know best regarding the nature of the yeast cells, the food which we know they take in large quantities, and upon which they live, is certainly exceedingly complex, and what the yeast cells take up in preference is certainly sugar, and the very complex nitrogenous substances which are at present in solution in the malt, and the products which they give off are exceedingly simple in comparison. Their functions are in the main (those which we know best, at any rate) analogous to those which take place in animal organisms, and are most remote from those which take place in vegetable organisms.

In a paper which he has recently written on the subject of fermentation, Liebig has drawn attention, amongst other things, to the circumstance that the common alcoholic ferment can be made to eat tartaric acid. If you were to neutralise a solution of some of these crystals in water, and put with the solution some yeast cells, at the same time supplying some nitrogenous material, the yeast plants would grow, and transform that into other substances. In the same way, if you were to put in some of this malic acid (which got its name from the circumstance that it is present in sour apples), the yeast cells would also transform that; and the same in other cases. One of the most remarkable decompositions is that of nitric acid, which, by the action of the yeast cells, is deprived of some of its oxygen, and converted into nitrous acid, so that it would appear that the plant can actually assimilate or eat the nitrates, forming these simpler derivatives from them.

There is one case which I should like to show you, of an inorganic action, one in which there is no vital process concerned, but it bears a sort of general resemblance to what I conceive to be the principle of those which I have been speaking of. I have here a piece of platinum in a peculiar state, which is well described by the term "spongy." If I hold it in the flame of common coal-gas mixed with air, from a Bunsen burner, the spongy platinum eats the air or the oxygen contained in it and the gas. The word "eat" is not really so inappropriate as it may seem. If I were to put this spongy platinum into oxygen, I should find that it would combine a quantity of oxygen into its substance, and make it part of itself, and the same with regard to the coal-gas. So that here you see, from the heat which was given off, the substance is really effecting a chemical change upon the materials which it absorbs, and it effects that change in its own substance. It is admitted that, in some way or other, the yeast organisms—I will not again call them plants—actually assimilate and make part of themselves, the sugar, or tartaric acid, or whatever it may be which they decompose; but they do not give off that substance which they have eaten in the same form. They give off its elements, after they have undergone a re-arrangement in other ways. At our next meeting I propose to bring before you some different considerations regarding the vital functions of these organisms, and some points which bear upon questions of sanitary importance.

(To be continued).

## ON THE ESTIMATION OF GRAPHITE IN CARBURETTED IRON.

By M. BOUSSINGAULT.

CAST-IRON and certain kinds of steel contain carbon in two different states, viz.: (1) combined with the iron and therefore not visible in separate particles; (2) disseminated through the metal either in the form of an amorphous black powder, or in that of brilliant crystalline laminæ, constituting the graphite of the metallurgists. There is some ground for the belief that while cast-iron is in the molten state all the carbon it contains is then

chemically combined therewith and dissolved, as it were, in the iron, but, on cooling, it appears as if a portion of that carbon is set free. Black granular cast-iron (granular on the fracture) exhibits a number of lamellæ of graphite. This is less prominent in grey cast-iron, and it is not visible in white cast-iron, neither in the kind called spiegeleisen, in both of these it can only be detected by careful analysis. When carburetted iron is dissolved in chlorhydric acid, the state of the carbon is at once shown. The free carbon or graphite remains along with the other insoluble matters. When iron does not contain graphite, but only combined carbon, there is no carbonaceous residue left on the iron being dissolved in hydrochloric acid, but in that case the carbon is eliminated during the solution of the iron in acid, communicating at the same time to the hydrogen gas evolved a peculiar and characteristic foetid odour. Steel which contains neither graphite nor scoriæ (siliceous and other matters derived from the flux) dissolves in the acid without leaving a residue. When a grey cast iron is dissolved in hydrochloric acid, it will evolve a foetid hydrogen, but leave simultaneously a carbonaceous residue, because such kind of iron contains carbon in the two conditions of combination, as well as mixture.

In the year 1799 Proust first called attention to the oily matter developed during the action of an acid upon black cast-iron. He discovered that a portion of this oil was carried off by the hydrogen gas, communicating to it an alliaceous odour, while another portion remained combined with the carbonaceous insoluble residue, from which it might be extracted by means of alcohol. When cast-iron is acted upon by hydrochloric acid the graphite contained in the iron is separated, while the combined carbon is eliminated during the reaction along with the hydrogen gas. The graphite left as a residue insoluble in acid can be quantitatively estimated by burning it in oxygen gas, its weight being determined by the loss of weight of the insoluble residue, provided the iron were fully dissolved, and even if some portion of that metal has remained undissolved, it is possible to estimate the quantity of graphite by this method, by so arranging the apparatus as to admit of weighing the quantity of carbonic acid obtained. When we have to deal with a mixture of graphite and carbon of combination, such as is, for instance, obtained by the action of bichloride of mercury upon grey cast-iron, the quantitative estimation of the two species of carbon is effected by first heating the mixture to a temperature not exceeding dull red heat, and with contact of air, whereby the combined carbon burns off, and the graphite being left is next consumed in a current of oxygen aided by a white heat; there remains after that the silicate due to the silicium of the iron. This silica sometimes contains slag. After every combustion it is best to heat the residue in a current of hydrogen gas, in order to reduce again to the metallic state any iron which might have been left among the carbonaceous matters. I have especially adopted this method of estimation of graphite and combined carbon in iron in order to save the trouble of recurring to the long and tedious process of organic elementary analysis. Although the estimation of graphite and combined carbon in iron by the method founded upon the different combustibility gives very correct results, I have deemed it necessary to compare these results with those obtained by the previous separation of graphite followed by its combustion, while simultaneously I could study the nature of the residue left by a graphitic iron when dissolved in an acid.

(1) *Doubly Cemented Steel*.—1.5 grms. treated by the bichloride of mercury yielded:—

	Grm.
After volatilisation of the protochloride, } carbonaceous matter .. .. . }	0.030
After combustion in air and reduction (by } hydrogen), a graphitic residue .. .. }	0.013



Carbon burned in air .. .. .	0.017 *
After combustion in oxygen and reduction, } greyish white residue of silica .. .	0.005
Carbon burned in oxygen .. .. .	0.008
Therefore 1 grm. of steel contains:—	
Combined carbon .. .. .	0.0113
Graphite .. .. .	0.0054

(2.) Five grms of the same steel have been treated with chlorhydric acid. When the metal is dissolved the liquid has been boiled for a few minutes, the insoluble residue has been collected upon a plug of asbestos placed in the neck of a funnel, washed with boiling hot water, dried, and next heated to redness in a current of hydrogen gas.

The remaining residue weighed .. .. .	Grm. 0.058
A whitish residue after burning in oxygen .. .	0.025
Graphite burned .. .. .	0.033
For 1 grm. of steel:—	
Graphite .. .. .	0.0066
Estimation according to 1. .. .. .	0.0054
Difference .. .. .	0.0012
1 grm. of steel has yielded:—	
Silica according to 1 .. .. .	0.0034
Silica according to 2 .. .. .	0.0050

As regards the silica I ought to observe that neither of the two methods answers the purpose of correct estimation of that substance, because a portion of the silica is dissolved.

#### White Cast-Iron of Ria (Pyrénées Orientales).

(1.) 1.5 grms. of this cast-iron treated with mercury yielded:—

Carbonaceous matter .. .. .	Grm. 0.089
After combustion in air and reduction, } slightly grey-coloured residue of silica } .. .	0.028
Burned-off carbon .. .. .	0.061
For 1 grm. of the cast-iron:—	
Carbon burnt off .. .. .	0.0406
Silica .. .. .	0.019†

(2.) Five grms. of the same cast-iron has been acted upon by hydrochloric acid. The hydrogen gas given off during this operation had a very foetid odour. The liquid containing the insoluble residue had been boiled, and, further, been treated as already mentioned above in the case of the steel similarly treated.

The greyish coloured residue after reduction weighed .. .. .	Grm. 0.043
Weighed after being heated in oxygen and reduction .. .. .	0.040
Graphite burned .. .. .	0.003

The remaining residue was silica-like, quite white, and disappeared when treated by fluorhydric acid. One grm. of this cast-iron yielded, therefore, by this process:—

Graphite .. .. .	Grm. 0.0006
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The quantity of combined carbon which has disappeared during the dissolution amounts to 0.203 grm.

#### Grey Hot-blast Cast-Iron from Ria (Pyrénées Orientales).

(1.) Treated with bichloride of mercury 1.5 grms. of this metal yielded:—

\* Combined carbon.  
† Since the mixing with the bichloride of mercury has been performed in a glass mortar, there is a chance of silica having thus been introduced.

Carbonaceous matter .. .. .	Grm. 0.0645	For 1 grm.
After combustion in air and reduction .. .	0.0540	—
Burnt-off carbon = combined carbon .. .	0.0105	0.0070
After combustion in oxygen and } reduction, white silica left .. .	0.0050	0.0033
Burnt-off graphite .. .. .	0.0490	0.0327

(2.) Five grms. of the same cast-iron treated with hydrochloric acid left a black-coloured residue, which, after having been treated as mentioned above, weighed:—

After combustion in oxygen, white silica left .. .	Grm. 0.257 0.105
Graphite burnt off .. .. .	0.152

This amounts for 1 grm. of cast-iron to—

Graphite .. .. .	0.0304
Silica .. .. .	0.010

As already stated above, neither the treatment with bichloride of mercury nor with hydrochloric acid gives proper results for the quantitative estimation of the silica. When the Ria cast-iron is acted upon by *aqua regia*, and the process so conducted as to render all the silica insoluble in weak acid, 1 grm. of the metal yielded 0.0234 grm. of silica, equal to 0.0111 grm. of silicium. When grey cast-iron is dissolved in chlorhydric acid it is very probable that silicium is converted into silica, for I have found that when artificially-prepared siliciuret of iron is treated with an acid, silica only is obtained, partly in soluble, partly in insoluble, condition. If the carbonaceous residues above mentioned had contained a siliciuret or protoxide of silicium, the weight of the substances determined would have become greater than the quantity of matter submitted to combustion in consequence of the absorption of oxygen by the silicium. The results of these experiments are:—(1) When a carburetted iron is dissolved in chlorhydric acid, the total quantity of the carbon combined with the metal is eliminated, while the free carbon remains mixed with the other substances insoluble in the acid. (2) Since the residue left by a grey cast-iron treated by hydrochloric acid, contains a portion of the silicium which was combined with the iron in the state of silica, that residue does not contain any graphitoid silicium nor protoxide of silicium; the estimation of the silica in the residue does not represent the whole of the silicium contained in the cast-iron, because a portion of the silica remains in the acid liquid. (3) That the process based upon the difference of combustibility of the combined carbon and graphite is sufficiently exact to estimate the two kinds of carbon obtained by the action of bichloride of mercury upon the carbonaceous residue of cast-iron or steel.—*Ann. de Chim. et Phys.*

## NOTICES OF BOOKS.

*Report of the Deputy Master of the Mint on European Mints.* Ordered by the House of Commons to be printed, August 10th, 1870.

This report has been drawn up by the Deputy Master of the Mint, in obedience to an order of the Lords Commissioners of Her Majesty's Treasury, whereby that gentleman and two officers of the Mint were requested to make a careful inspection of the management and working of the principal Mints of Europe; that is to say, those established at Madrid, Milan (where the Mints of the kingdom of Italy are in process of concentration), Florence, Rome, Constantinople, Vienna, St. Petersburg, Stockholm, Copenhagen, Berlin, Utrecht, Brussels, and Paris. We shall only quote from the Deputy Master's Report the headings of the subjects treated of, viz., Administration,



Mint Buildings, Refining, Standard of Fineness, Remedy of Fineness, Brittle Gold, Silver Melting, Levot's Experiments, Method of Taking Assays, Waste, Sweep, Dies, Verification of Gold Monies, Verification of Silver Monies, Annealing and Blanching, Size of Moulds and Bars, Rolling, Adjusting, Cutting, Adjustment of Blanks, Weighing Blanks and Coins, Remedy of Weight, Marking, Coining Presses, Balances.

Our readers will readily perceive from this catalogue that many subjects are treated of which, however interesting in themselves as bearing upon the speciality of the requirements of those manufacturing establishments which are termed Mints, are of less interest to the chemist.

There are, however, added to the report two appendices, termed enclosures, written by the gentlemen who accompanied Mr. Fremantle, the Deputy Master, on his inspection tour, the first thereof being from Mr. W. Chandler Roberts, Chemist to the Royal Mint, the other from the hand of Mr. James Murdoch Napier. This second report bears almost entirely upon mechanical operations, and, although of high value, and evidencing in a high degree the author's eminent knowledge in this respect, we will not further allude to it here, but confine our quotations to those taken from Mr. Roberts's extensive and valuable report.

The points named for consideration in this report are—

"Refining. Gold alloys. Gold melting. Silver melting. Subsequent treatment of gold and silver (annealing of fillets, annealing of blanks, and blanching). Loss. Treatment of residues or 'sweep.' Verification. Adjusting blanks. Dies. Bronze."

Under the head of Refining, the following information is given on brittle gold:—

"Immediately connected with this subject is the fact that gold frequently contains minute traces of lead, arsenic, antimony, and bismuth. These metals, even when present, to the 1-2000th part of the mass, render the gold brittle and totally unfit for coining, probably by enabling the alloy known as standard gold to assume a crystalline structure. I find that on the Continent, those countries which have an extensive gold currency are but little troubled with brittle gold. The reason is obvious; the impure metals are removed by refining, which forms, as I have stated, one of the ordinary operations of the Mint; and the utmost care is taken to conduct the process in an efficient manner. With regard to the direct treatment of brittle gold, it is needless to remind you that the experiments in the English Mint have proved the advisability of adopting Miller's process."

Since the melting of the valuable gold and silver alloys as used for coinage is an operation of great importance we quote in connection therewith the following:—

"Gold Melting.—I now proceed to the description of gold melting. The nature of the gold to be operated upon, and its degree of fineness, having been determined by assay, a simple calculation will give the amount of copper to be added to form standard gold.

"Crucibles.—The crucibles in which gold is melted were formerly of refractory clay, and this material is still retained in the Mints of France and Belgium. It has in England been superseded by a mixture of graphite and fire-clay, known as plumbago. The amount of gold melted in each crucible is, in the British Mint, from 100 to 108 lbs. (or 37.3 to 40.3 kilogrammes), and I find a similar quantity is operated upon in other European Mints, the exceptions being those of St. Petersburg, Paris, and Vienna, which usually melt a larger quantity. The admixture of the metals is a matter of extreme importance, and this is effected by means of a stirrer of the same material as the crucible, in the form of a rod flattened at the end, and often of a spiral form. The copper is in all cases protected from oxidation by placing charcoal in the crucible.

"Method of Pouring.—In the English Mint the crucible is removed from the furnace by means of circular tongs,

and the contents poured directly into moulds. In many European Mints it is the practice to transfer the melted alloy from the crucible to the moulds by means of iron ladles covered with clay.

"Mode of taking the Portion of Metal for Assay.—In England it is usual to cut the portion of metal to be assayed from the bottom of the solidified bar. In many continental Mints the portion of metal taken for the verification of the standard is removed by a small ladle from the crucible; and at Constantinople the sample is taken after half the alloy has been transferred to the moulds. The bars of standard gold for the coinage of sovereigns at the English Mint are 1.375 inches wide, 1 inch thick, and 24 inches long. In other European Mints, with the exception of that at St. Petersburg, bars are cast of much smaller dimensions, those in Berlin being only three sixteenths of an inch thick. I consider that this practice presents many advantages, but in this case I defer my remarks until treating of silver melting.

"Gold-melting Furnaces.—I have examined with care the furnaces employed for gold melting. That furnace is best in which the combustion of the fuel is most perfectly effected; indeed I had hoped to have met with gas furnaces, as I am of opinion that their introduction into the English Mint would be very advantageous, not only from their cleanliness, but from the fact that the temperature would be completely under control. At Milan it was stated that plans are in preparation for the construction of gas furnaces, and should the Mint be removed from its present site, the advisability of the employment of gas as fuel shall receive my earnest consideration. The furnaces employed in the English Mint for melting gold are 24 inches (0.61 metre) deep by 12 inches (0.305 metre) square. I do not consider that any change should be made in the general construction of the furnaces as at present in use in the British Mint, but with regard to minor details, I am of the opinion that the openings might be altered with advantage. It is also a question for consideration whether, if the furnace opening were on a level with the floor, the necessary manipulation would be attended by less inconvenience to the operators. This arrangement is adopted at Stockholm, where, however, the amount of gold melted is extremely small."

"Crucibles for Silver.—The crucible at present employed in England for silver melting is of wrought-iron, 12 inches (or 0.305 metre) in diameter, and capable of containing from 333 lbs. to 416 lbs. of metal. At Milan silver is melted in very thin wrought-iron crucibles, in which 1607.5 lbs. (600 kilogrammes) are acted upon at one operation. The iron is protected by a thin but coherent film of fire-clay. At Brussels the crucibles are also of wrought-iron, of 2679 lbs. (1000 kilogrammes) capacity. The Vienna, St. Petersburg, and Utrecht Mints employ crucibles of cast-iron, capable of containing from 1607 to 2143 lbs. (600 to 800 kilogrammes). Those of Madrid, Constantinople, Rome, and Berlin employ crucibles of graphite, the capacity varying from 535.8 to 2529.1 lbs. (200 to 944 kilogrammes), as at Constantinople. I have no hesitation in recommending that graphite crucibles should be employed in preference to iron. Iron crucibles invariably absorb portions of silver either in the scales of wrought-iron, or even in the actual cavities of cast-iron. Indeed the crucibles at Vienna often contain many pounds of silver, and this is recovered by dissolving the iron with acid residues from the refinery. One other objection is that the silver becomes contaminated with iron. Graphite crucibles permit of the total contents being poured into moulds, and this enables the accounts to be adjusted daily, a point of Mint administration the value of which cannot be over-rated."

"Graphite Crucibles.—Experiments have recently been instituted in the English Mint, upon silver melting in graphite crucibles, containing 143 lbs. (53.37 kilos.), and have been attended with excellent results. The silver is either directly poured into moulds, or transferred by means of iron ladles lined with clay. In England the



silver bars are one inch thick; whereas, as I have already stated with regard to gold, in most European Mints the bars are of much smaller dimensions. In most European Mints, before the silver alloy is cast into bars, the contents of the crucible are stirred, and a small quantity of the metal removed by a ladle lined with clay or (as at Utrecht) by a pair of forceps which open in the molten mass, and enclose a button of metal. This test piece is assayed by the volumetric method, a process which occupies from 15 to 20 minutes, and, as in most cases the amount of alloy operated upon is very considerable, there is no inconvenience in maintaining the contents of the crucible in a molten state until the assay is completed. The melter is thus enabled to adjust, if necessary, the relative proportions of the constituent metals. The portion of metal taken from the crucible represents the actual composition of the standard silver with far greater accuracy than a test piece cut from the end of the bar of the solidified alloy."

"*Levol's Experiments.*—In order to explain this, it is necessary for me to enter somewhat minutely into the consideration of an important series of experiments conducted in the Mint at Paris by Levol, on the remarkable molecular mobility of alloys, in virtue of which certain combinations of the constituents of a molten alloy become segregated from the mass, the homogeneous character of which is thereby destroyed. Thus, to take an extreme case, an alloy containing 77.33 per cent of silver, and 22.67 per cent of copper was cast in a cubical mould of 42 millimetres. A portion cut from the centre of the mass gave on assay 78.318 per cent of silver, while a portion cut from one of the angles was found to contain only 77.015 per cent of silver, showing a difference of 13.05 millimes. Levol proved that it is only the alloy containing 71.893 per cent of silver and 28.107 per cent of copper which is absolutely homogeneous. It is interesting to note that there is, as far as I am aware, no monetary alloy having this composition; the nearest, the Swedish standard, containing 75.00 per cent of silver. He also finds that while the alloy containing 71.89 per cent of silver is homogeneous, in all alloys containing more silver than this amount the centre of the solidified mass is richer than the exterior; on the other hand, in alloys of fineness lower than 71.89, the centre contains less silver than the external portions. It is of great interest to observe the results of an experiment on a cubical mass of 42 millimetres, similar in composition to the British standard. The maximum difference between the centre and one edge was 9.95 per mille, while the mean variation between the composition of pieces taken from different parts of the mass was 2.96 per mille. Fortunately the gold-copper alloys employed in the British and other European Mints present a very slight variation in composition, due to molecular arrangement. I may remark that the copper in the standard gold alloy has a singular tendency to oxidise even to the centre of the mass, a phenomenon in which I cannot but think the actual occlusion of oxygen plays an important part.

"Without entering into further details, I would draw the following practical conclusions:—

"1. The molecular re-arrangement must take place during the solidification of the mass, and the thin bars, therefore, which are in use on the Continent possess a decided advantage over the thicker ones in use in the British Mint, from the fact that they are more rapidly cooled.

"2. The continental method of taking the portion of metal for assay should be adopted in the British Mint, the composition of the alloy being much more accurately represented by a portion from the recently stirred fluid mass, than a test piece cut from the end of a solidified bar.

"3. Although the defects due to the non-homogeneous character of the alloy are to some extent modified by rolling the bars, still the centre of a fillet of standard silver often differs by at least 2.3 per mille from the edges, and a five-franc piece, therefore, will

vary in composition in different parts of the coin, the centre being the richest; or if (as is the case with the shilling) two coins are cut in the width of a fillet, the portion containing most silver will be near one edge of each coin.

"In England the method of cutting a piece from a silver coin for assay may not give a correct result, as a segment, or even a strip cut through a coin, may fail to indicate its composition with absolute accuracy. M. Stas, the head of the Belgian Mint, introduced the following accurate method. Small cylindrical or square portions are punched from various parts of the coin, the number and exact position of such pieces having been determined for each denomination of coin by calculations founded on an elaborate series of assays. I am indebted to M. Arthur Nyst, assayer of the Belgian Mint, for the results of experiments on the coins of that country."

The subjects of loss, treatment of sweep, and verification, being of considerable interest to chemists are quoted at length.

"*Loss.*—The metallurgical treatment of the precious metals is attended with unavoidable loss.

"In the English Mint the amount of loss on gold melting is considered to be 0.173 per mille, or one grain on the Troy pound. The apparent loss on silver melting under the new arrangements of the melting house is two grains on the Troy pound, or 0.346 per mille, much of the metal being recoverable from sweep. I have experienced great difficulty in obtaining accurate information with regard to the amount of loss that accrues during the manipulation of gold and silver in various European Mints. The following details were furnished to me:—

"In Mint A there is allowance of one per mille for loss on gold and 2½ for silver.

"In Mint B, a loss of one per mille for gold was considered to be a low estimate.

"In Mint C, the average loss was 0.7 per mille for gold, and 2.5 for silver.

"In Mint D, the loss on gold was stated to vary from 0.2 to 0.4 per mille.

"The officers of the English Mint consider that the loss on the gold coinage will, for the future, certainly not exceed £200 on a coinage of one million, or 0.2 per mille.

"*Cause of Loss.*—The loss which arises from melting gold may be caused by volatilisation in combination with copper or other more volatile metals. I have stated above that the loss on gold melting has been found to be 0.173 per mille; but it has been experimentally proved by melting ingots, that there is a loss of 0.054 per mille due to foreign matters, weighed as alloy before the fusion. The precious metal actually volatilised may be arrested by condensation. This point has received much attention in the Roman Mint, where the flues of the gold-melting furnaces have been placed in communication with condensing chambers of simple construction, the adoption of which has been attended with very satisfactory results.

"I have already alluded, under the head of blanching, to a source of loss on melting worn coins. I now beg to call your attention to a point of much interest, experimentally developed by Dr. van Riemsdijk, who finds that the silver coins of five countries contain oxide of copper, in amounts varying from 0.3 to 2 per mille. On remelting old coin and scissel, there is a loss in weight, often of as much as 0.25 per mille, due to the reduction of oxide of copper to metallic copper by the charcoal under which the alloy is melted. Although I have no accurate information with regard to the loss on gold coins and scissel, still I am convinced that, with the present methods of annealing practised in the British Mint, the amount of loss arising from the above cause must be very sensible. It is true that the loss in weight is attended by a corresponding elevation of standard, but it nevertheless remains a distinct element of 'waste.'

"*Treatment of 'Sweep.'*—Under the term 'sweep' is comprised dust collected from the floors, ashes, dust from



flues, scrapings from crucibles, and residues generally which are likely to contain precious metal. At present it is the practice in the Mint in this country to grind the old crucibles, and to sift the product with the rest of the sweep through a sieve of 400 meshes to the square inch, the finer portions being sold to the highest bidder. In most European Mints the precious metal is extracted from the residues by the amalgamation process. I propose to make experiments with Mr. Crookes's sodium amalgamation process. I am not prepared to state that the extraction of the precious metal from a comparatively small quantity of sweep would be a source of actual profit, but I recommend that the operation should be undertaken by the Mint itself; for, as the gold and silver would be recovered in the metallic state, any deficiency would be absolute loss, and the amount of such loss would afford an intelligible indication of the degree of perfection attained in the conduct of the various operations.

"*Verification, or Assaying.*—The method of gold assaying at the Mint in this country is identical with the process agreed upon at the Mint conference held at Vienna in 1857, and it is not possible to suggest any improvement in this respect, the excellent platinum apparatus of Messrs. Johnson and Matthey having been recently introduced into the establishment. In England, muffles heated with anthracite are employed, while at Berlin solid fuel is replaced by gas. I have no practical experience of muffles heated by gas, but the advocates of the method consider the temperature to be more completely under control.

"The method of silver assaying by cupellation is still employed in the British Mint, and, before proceeding to consider the practice of other European Mints, I may state that the chief objection to the method is the number of 'check assays' on standards of known composition rendered necessary by the variability of the temperature during the operation. In all other Mints the silver assay by cupellation has been superseded by the volumetrical method devised by Gay Lussac. The results are not accurate if the alloy contains mercury, as this metal interferes with the reaction. The process cannot be conveniently applied to silver alloys the composition of which is not approximately known, but this objection does not apply to the practice at the Mint, as trade assay reports are in all cases furnished with the ingots. The usual mode of conducting the volumetrical process is attended by certain errors arising from the solubility of the chloride of silver in the solution employed as a precipitant, and from the liberation of chlorine by the conversion of chloride of silver into subchloride by the action of light. These points have been investigated by M. Stas, and after a research detailed with the elaborate care so characteristic of his work, he finds extreme accuracy may be attained by substituting hydrobromic acid for the hydrochloric acid or chloride of sodium ordinarily employed. One great advantage of the modification of the process consists in the last traces of the silver being rapidly precipitated, and more easily distinguished than is the case with chloride of silver. Indeed, by employing an extremely accurate drop apparatus, the possibility is asserted of distinguishing the precipitate produced by a single drop of the decimal solution, or, in other words, the presence of the half of one-tenth of a milligramme (0.00005 grm.) of silver. The decomposing action of light is avoided in the Mints of Utrecht and Brussels by means of windows of yellow glass. I therefore suggest that experiments should be made in the Mint, to test side by side the cupellation and volumetrical methods, and that at the same time the manipulatory precautions suggested by M. Stas should be adopted.

"There is one other method of assaying practised in India; it consists in weighing the precipitated chloride of silver. The results obtained are very accurate, but the process entails much labour and delay, and I am not aware of its having been adopted in any European Mint."

While we have thus largely quoted from this excellent Parliamentary paper, we advise those of our readers who may be inclined to study this subject to read the whole of these fifty pages, which are obtainable for the very moderate sum of 3½d.

The authors unanimously bear testimony to the very courteous and polite reception accorded to them everywhere on the Continent.

## CORRESPONDENCE.

### MAGNETISM AND DIAMAGNETISM.

*To the Editor of the Chemical News.*

It may interest some of your readers if I mention an experiment I tried the other day, revealing a fact which I have not seen mentioned elsewhere; more especially as it bears on an important magnetic law.

I took two magnets of about equal weight and power, and compared the attraction they had for one another with that which each had for a piece of soft iron. I found that, when in contact, the attraction for each other was the same as that of either for the soft iron; but at a short distance the former was double of the latter. The question which this result bears upon is this—when one pole of a magnet is in contact with a piece of iron or steel, does it produce in it a pole of an opposite name, or only of the same name? At a short distance, there is no doubt that it produces, in the part nearest itself, a pole of an opposite name, and that, as the distance diminishes, the two neutral lines, one between the magnet and the iron and the other in the iron itself, draw nearer and nearer to the point of contact. When there is actual contact, do these neutral lines vanish? All our text-books assume the negative. Du Moncel, in 1858, asserted that this was a mistake; and when there is actual contact, he declares there is no trace of any neutral line or of a pole of opposite name to the pole of the magnet. From such experiments as I have been able to try, I should say that if the pole of the magnet and the end of the piece of iron be exactly the same size, and perfectly ground so as to come into very close contact, the neutral lines disappear; but where this is not the case, the neutral lines disappear only at those particular points which are in actual contact, and that in those which are at a short distance there is a real double polarity. The experiment is very difficult to try; for if steel-filings be used, which is the simplest plan, it is almost impossible to prevent some particles from springing between the magnet and iron and so preventing perfect contact; and if we make an examination with a steel needle, the superior attraction of the magnet gives an appearance of repulsion between the needle and the points of the iron which are near to the magnet. But I think this appearance is deceptive; for the nearer the end of the needle is brought the less the repulsion, and when in contact there is an attraction; but again, this is sometimes produced by the reversal of the magnetism of the needle. Of course a single grain of dust of any kind between the magnet and the iron vitiates the experiment. At any rate, the little pictures given in our text-books (take, for instance, Ganot's "Physics," and Watts's "Chemical Dictionary") are drawn from mere fancy, and give an entirely erroneous idea of the facts as they are in nature.

While I am on this subject, let me observe that all the phenomena of diamagnetism, so-called, are perfectly explicable on old and well-known principles, without introducing any new property of matter. The distinction between magnetic and non-magnetic bodies, or rather between bodies more or less magnetic, is well known. Now when a body of small or no magnetic power is placed between the poles of a strong electro-magnetic, if it approaches either pole a voltaic current must be produced by this approach, parallel to and in an opposite direction to



the currents circulating round the pole of the magnet, and, therefore, a repulsion takes place. At the same time, as it was receding from the opposite pole, a current was formed parallel to and in the same direction as that circulating round this second pole, and therefore attraction takes place. Therefore, if the body, placed ever so little equatorially, approaches either pole, a current is formed, passing in a circuit round the length of the body, repelling it from this pole and attracting it to the other. These forces are in equilibrium only when the body stands equatorially at equal distances from each pole. In crystalline bodies the conducting power in different directions is modified by the axes and cleavage of the crystal. Hence these bodies comport themselves differently from non-crystalline bodies. *And here lies the whole mystery of diamagnetism.* When the specific conductivity of a body exceeds its specific magnetic power, it is diamagnetic; when otherwise, magnetic.

As it is very desirable to simplify, as much as possible, and diminish the number of natural laws, this simple and adequate explanation of the phenomena, which I have never seen given elsewhere, seems not unimportant.—I am, &c.,

H. HIGHTON.

Putney, December 22nd, 1870.

PS. In order to explain quite thoroughly from first to last the action of *diamagnetism* we must go a little deeper. Suppose any conducting body placed between the poles of an electro-magnet; the circuit is then closed; what is the consequence? According to well-known laws, two temporary currents are produced along the two longitudinal surfaces of the conductor which are nearest the poles of the magnet, both currents moving in the same direction, and both repelling the conductor from the poles of the magnet. These currents would form a circuit by returning along the interior longitudinal axis of the conductor. The conductor thus repelled from each pole takes up its equatorial position between the poles of the magnet at an equal distance from each; and is then kept there by the action described above, which prevents it approaching either pole. Let me add that all currents act more or less in pulsations; that, as each pulsation swells, currents are produced, repelling any body from each pole; as each decreases, currents are produced, attracting to each pole equally; thus, again, the equatorial position is the only position of equilibrium.—H. H.

#### SOLUBILITY OF TIN IN NITRIC ACID.

To the Editor of the Chemical News.

SIR,—Nearly eleven years ago, I observed that metallic tin was soluble in moderately dilute nitric acid at or near the freezing-point of water, and that this solution appeared to decompose with production of metastannic acid at temperatures above 41° F., or even at a lower degree if exposed to bright light.

I spoke of this tin solution in the year 1860, to my friend the late Mr. Frank B. Fowler, but he then expressed himself as having heard of the fact being published previously. Mr. Fowler afterwards invited me to go and see "some crystals obtained in *vacuo* from our tin solution," but his illness upset the arrangement.—I am, &c.,

WENTWORTH L. SCOTT.

#### THE SPECTROSCOPE IN WATER-ANALYSIS.

To the Editor of the Chemical News.

SIR,—In studying the best modes of rapidly detecting and localising the sewage contamination of a particular water-supply, I was led to devise a plan which, so far as I can tell at present, promises to be of great service. I will briefly illustrate its nature and use by an example.

On one side of a crowded court several cases of typhoid fever had been developed. The water used by the inhabitants of these houses was drawn from a rather shallow well, and was highly charged with various unoxidised compounds of nitrogen. It was suspected that the drain from a public urinal might be defective and have allowed egress of its contents into the well. This notion was confirmed by the quantity of common salt contained in the well-water, namely, seven times as much as that in the normal waters of the neighbourhood. But it received an absolute proof in the following novel manner. Two grammes of a *lithium* salt were introduced into the urinal. Two hours afterwards lithium was detected spectroscopically in a litre of the well-water before alluded to. A quantity of this water, ten times as large, showed no trace of lithium previously.

It is needless to point out the wide adaptability of this method to the detection of the particular source or sources of contamination in a water. Other metallic salts might be used, but those of lithium commend themselves on account of their harmlessness and ease of detection. They do not seem, moreover, to be much absorbed by most soils and gravels, and so are not stopped in their way to the wells.

Further experiments in the direction indicated in this brief note are in progress.—I am, &c.,

A. H. CHURCH.

Royal Agricultural College, Cirencester.

December 22, 1870.

#### MISCELLANEOUS.

University of London.—The following is a list of the Candidates who have passed the recent examination:—*Second B.Sc. Examination (Examination for Honours).*—Chemistry.—First Class. Robert Routledge (disqualified by age for Scholarship), Owen's College. Henry Newell Martin, Christ's, Cambridge, and University College, London. Second Class. Frank Clowes, College of Chemistry and private study.

Glasgow Philosophical Society (Chemical Section).—A meeting was held in the Society's rooms, Corporation Buildings, on Monday evening, the 5th inst., at eight o'clock. W. R. Hutton, Esq., in the chair. Dr. Wallace, F.R.S.E., President of the Section, and Gas Examiner for the City of Glasgow, delivered a lecture "On the Illuminating Power and Impurities of Coal-Gas." At the following meeting, held on the evening of the 19th inst., Mr. Robert R. Tatlock, F.R.S.E., read a paper "On Some Sources of Error in Volumetric Analysis," an abstract of which will appear in our next.

#### CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

The American Journal of Science and Arts, No. 150, November, 1870.

This number opens with the announcement that a third series will be commenced on the 1st of January, 1871. This series will be issued in monthly numbers of seventy-six pages, making two volumes a year of 456 pages each. Subscription for the year, 6 dollars or 50 cents a number.

Examination of the Bessemer Flame with Coloured Glasses and with the Spectroscope.—J. M. Silliman.—This important paper is reproduced *in extenso*.



**A Simple Method of Measuring Electrical Conductivities by means of Two Equal and Opposed Magneto-Electric Currents or Waves.**—Dr. A. M. Mayer.—This paper is illustrated with a series of woodcuts, and therefore is not well suited for abstraction.

**Account of the Fall of a Meteoric Stone in Stewart County, Georgia, U.S.**—Dr. J. E. Willet.—It appears, from the detailed account given in this paper, that on October 6, 1869, about 11:30 a.m., a meteorite fell from the sky, which was perfectly clear and cloudless at the time. The fall of the stone was attended by a very strong explosion. The stone was recovered almost immediately after it reached the earth; it gave off a peculiar odour; weighed 12½ ozs.; its colour within very like light-coloured granite; externally, it was covered with a smooth, almost black-coloured shell, a little thicker than common letter-paper; its shape was an irregular, seven-sided figure, its longest side being about 2½ inches long.

**Description and Analysis of a Meteoric Stone that Fell in Stewart County, Georgia, U.S., on the 6th of October, 1869.**—J. Lawrence Smith.—The author, on more closely investigating the stone alluded to in the foregoing paragraph, found its specific gravity to be 3.65. The fractured surface has a greyish aspect, and, when examined with a magnifying glass, exhibits numerous greenish globules, with a whitish granular material between. Through the mass are dark particles consisting principally of nickeliferous iron, with some pyrites, and a few specks of chrome-iron. The nodules are sometimes 3 or more m.m. in diameter, and of an obscure, fibrous, crystalline structure; they have a dirty bottle-green colour, a greasy aspect when broken, and are more or less opaque. Some of these nodules were separated in a tolerably pure state, and amounted to 121 m.m. On analysis it was found to contain—Silica, 48.62; alumina, 8.05; protoxide of iron, 11.21; magnesia, 30.18;—total, 98.06. Nickeliferous iron constitutes about 7 per cent of the mass; and a portion thereof, separated in as pure a state as possible, yielded, on analysis—Iron, 86.92; nickel, 12.01; cobalt, 0.75. The part of the stone soluble in acid, amounting to 58.05 per cent, was found to consist, in 100 parts, of—Silica, 41.08; alumina, 0.32; protoxide of iron, 18.45; magnesia, 41.06. The portion insoluble in acid, amounting to 41.95 per cent, was found to consist, in 100 parts, of—Silica, 56.03; alumina, 5.89; protoxide of iron, 15.21; magnesia, 21.00; lime, 0.10; soda, with a little potassa and lithia, 2.97. The soluble part is olivine, while the insoluble is bronzite, with a little albite or oligoclase. Chrome-iron was detected by fusing some of the stony part of the meteorite with carbonate of soda and a little nitrate of potassa, and separating in the usual way; the quantity was quite minute. The composition of the stone, as made out, would be, in 100 parts—Nickeliferous iron, 7.0; magnetic pyrites, 6.10; bronzite or hornblende, olivine, albite or oligoclase, and chrome-iron, together, 86.90.

**Some Practical Remarks on the Use of Flame-Heat in the Chemical Laboratory, Especially that from Burning Gas, without the Aid of a Blast.**—J. Lawrence Smith.—This essay is full of practical value; but, as the woodcuts are absolutely required for the subject to be properly understood, we cannot give an abstract.

**Connection between Terrestrial Temperature and Solar Spots.**—C. Abbe.—A valuable contribution to our knowledge on this subject.

**Oxycalcium Light, as Applied to Photo-Micrography.**—Lieutenant-Colonel J. J. Woodward.

**Farmer's Theorem Discussed.**—F. E. Stimpson.—This paper, and the following—

**Note on Mr. Stimpson's Paper on Farmer's Theorem.**—B. Silliman.—Bear upon the paper "On the Relation between the Intensity of the Light Produced from the Combustion of Illuminating Gas and the Volume of Gas Consumed," written by the last-named author.

**Determination of the Photometric Power of a Rich Gas by Dilution with a Poor Gas of Known Value: the "Method of Mixtures."**—B. Silliman.—The conclusions arrived at by the eminent author as the result of a series of experiments made with great care at the Manhattan Gas Company's Works, New York, are—(1) That in all illuminating gas we have a substratum of non-luminous gas holding in solution a variable volume of luminous gas (olefines). (2) That, when a gas is too rich in illuminants to permit of accurate photometric admeasurement by the usual standards of intensity, it may be diluted, with a poor gas of known value and volume, to such a standard as is consistent with the accurate employment of the usual photometric apparatus, its true value being then calculated from known values employed.

**The Hailstorm of the 20th of June, 1870.**—Rev. H. C. Hovey.—An interesting description of this extraordinary phenomenon, as witnessed by the author at Northampton, Mass., U.S.. The paper is illustrated with several woodcuts exhibiting the structure and shape of the hailstones.

**Photograph of a Solar Prominence.**—Prof. C. A. Young.

**Geological Explorations in China.**—Baron von Richtenhofen.—This paper is a letter to Professor J. D. Whitney, dated from Peking, August 20th, 1869, and containing a series of interesting details relating to the geology of the Celestial Empire.

**Chemistry of the Bessemer Process.**—Lieut. C. E. Dutton, U.S.A.—Reserved for full reproduction.

**Earthquake of the 20th of October, 1870.**—The brief report of some observations made on this phenomenon, which occurred in a portion of the States and adjacent Canada territories.

*Zeitschrift für Chemie von Beilstein, No. 18, 1870.*

**Volatile Acids Contained in Croton Oil.**—A. Geuther and O. Frölich.—The authors saponified a large quantity of croton oil with a strong caustic soda lye. They removed the soap from the

mother liquor, and after having saturated this alkaline fluid with sulphuric acid in excess, submitted the resulting liquid to distillation in a copper vessel; the aqueous distillate was neutralised with soda, evaporated to a small bulk, and again treated with sulphuric acid in excess. The crude fatty acids thus obtained were rectified, and by this process four liquids of varying boiling-points were obtained, viz.: (a) boiling at from 115° to 160°; (b) at from 160° to 190°; (c) at from 190° to 205°; (d) at from 205° to 270°. The first portion of these fluids was found to contain butyric and acetic, but no propionic acids. In the second portion the authors expected to find crude crotonic acid; and also quartenylic acid, which boils at about 171.9°; but, as evidenced by the following results of organic elementary analysis— $C_5H_{10}O_2$ , in 100 parts, 58.8 carbon; 9.8 hydrogen; 31.4 oxygen; and  $C_4H_8O_2$ , in 100 parts—carbon, 55.8; hydrogen, 7.0; oxygen, 37.2—these figures show that acids belonging to the oleic acid series are not present in this fluid. The third portion, which crystallises on cooling, was found to contain an acid resembling angelica acid, a solid substance exhibiting colourless rhombic-shaped crystals, fusing at 64°, boiling at 201°. This body has been called tiglinic acid by the authors, for although its formula is the same as that of angelica acid; that acid is distinguished from the body here alluded to by its fusing and boiling points, which are respectively 45° and 190°. The authors further state that it is possible that this tiglinic acid (the name is derived from croton-tigilium) is identical with the methylcrotonic acid of Dr. Frankland and Mr. Duppa (*Ann. Ch. Pharm.* 136, 10). This supposition is strengthened by the fact that the ethyl ether of the tiglinic acid,  $C_5H_7O_2.C_2H_5$ , boils at the same temperature (156°), as found for the methylcrotonic acid ether by the savants just named, while the specific gravity also agrees (0.926 at 21°). The ethyl ether of tiglinic acid, moreover, corresponds in its properties with those of the methyl crotonic ether, being a colourless insoluble fluid, transparent in water, exhibiting a peculiarly aromatic smell. Tiglinate of barium,  $C_5H_7O_2.Ba + 5H_2O$ , a salt crystallising in a small acicular shape, readily soluble in water. Tiglinate of silver,  $(C_5H_7O_2)_2Ag$ , obtained by precipitating the solution of the baryta salt, is a white coloured crystalline powder, very little acted upon by the sunlight. The fourth portion of the fractional distillation was only obtained in small quantity, and was found to contain, as far as tests and analysis admit of certainty, capronic, or tenanthylic or pyrotenebic acid. The authors conclude that their researches on this subject entirely eclipse those of Dr. Schlippe, who has (*Ann. Ch. Pharm.* 105, 49) erroneously stated that the volatile acids of croton oil should contain crotonic acid,  $C_4H_8O_2$ , and angelica acid.

**Some Derivatives Obtained from Normal Propylic Alcohol.**—Dr. C. Schmidt.—The following compounds are treated of in this paper: Bromide of propyl,  $C_3H_7Br$ , boils at 71.5°; iodide of propyl,  $C_3H_7I$ , boils at from 100° to 102°; formic acid propyl ether, prepared by the reaction of formiate of soda upon the bromide of propyl, formula  $C_3H_7CHO_2$ , boils at 74°; sulphocyanide of propyl,  $C_3H_7.S.CN$ , an oily, disagreeable-smelling liquid, boiling at 163°, not belonging to mustard oil (essential) series. Propyl sulphuric acid yields a baryta salt. Formula:  $(C_3H_7SO_4)_2 + 3H_2O$ ; propylamine,  $C_3H_7NH_2$ , a fluid boiling at from 78° to 80°. The hydrochloride of this base is a very hygroscopic salt; the platinum salt,  $(C_3H_7.NH_2.HCl)_2PtCl_4$ , is bright yellow coloured; the sulphate,  $(C_3H_7.NH_2)_2SO_4$ , crystallises difficultly; cyanide of propyl,  $C_3H_7NC$ , boils at from 95° to 100°, and is a very foetid smelling liquid.

*Bayerisches Industrie und Gewerbe Blatt*, September and October, 1870.

**Review of the Mining, Mineral, and Salt Production in the Kingdom of Bavaria for the year 1868.**—A valuable statistical account of the mining and metallurgical industry of the country alluded to. The particulars extend not only to the salt production, but also to that of graphite, porcelain, clay, gypsum, emery, alum, pyrites, and other minerals.

**Water Supplied to the Towns of Kaiserslautern, Zweibrücken, Amberg, Bamberg, Bayreuth, Hof, Fürth, Erlangen, Rothenburg-on-the-Tauber, Nördlingen, Memmingen, and Neuburg-on-the-Danube.**—A. Wagner.—This exhaustive essay was made at the suggestion of the Bavarian Ministry for Trade and Public Works, and contains the following particulars about each of the towns above named, number of inhabitants, physical geography, geology of the soil upon which the towns are situated, hydrography, means and methods of supply of water, physical properties, and full analysis of the waters. The author taking as basis the quantity of total solid residue contained in 1 litre of each of the 64 samples of water, classifies the water into seven classes, the first containing from 0.0 to 0.3 grm. of total solid residue, and the last from 2.0 to more grms. Only 4.7 per cent of the waters analysed belong to the first class, while to classes 6 and 7 belong respectively 14 and 11 per cent, both of these kinds of water being considered unfit for use for domestic purposes. The contents of this paper are chiefly of local importance, but the researches prove the truth of the ancient maxim, *tales sunt aquae quales terra per quas fluunt*.

**Effect of Wind and Weather as Affecting the Draught of Chimneys.**—Dr. T. Huber.

**Gabbro Mass.**—J. von Schwarz.—Under this name the author prepares a plastic mass, consisting of two-thirds of steatite (chiefly a silicate of magnesia), one-third of pottery clay, and 1-16th of soda. The steatite is first ground with water and afterwards intimately mixed with the other ingredients. In a semi-dry state this mixture may be turned on the lathe the same as wood, but is chiefly used for making an excellent kind of pottery ware. When intended to be used instead of wood the mass may be coloured with aniline or other colouring matters.



## NOTES AND QUERIES.

**Manufacture of Kelp.**—(Reply to "A Student").—Consult Wagner's large work on "Chemical Technology," vol. v.; "Muspratt's Dictionary," and "Ure's Dictionary of Arts, Manufactures, &c.," all of which you can inspect at the library of the Commissioners of Patents.

**Aniline Colours.**—(Reply to "Stainer").—Your best plan is to consult the work on the "Aniline Colours," edited by the Editor of this journal, and published by Messrs. Longmans and Co., and also Schützenberger's work referred to on p. 312, No. 578 of this paper. As regards the alumina it is, in all probability, the amorphous and gelatinous oxide of aluminium which is meant by Mr. Perkin. Tannic acid forms insoluble compounds (lakes) with several of the so-called aniline colours.

**Turkey-Red.**—(Reply to "Magenta.")—Some years ago a brief account of some experiments made with aurine were published in our pages. By referring to these you will probably meet with what you want but Turkey-red is a misnomer, for it only applies to a speciality of madder dyeing; the aurine colours are not fast, but very beautiful. Rosolic acid, when dissolved in alcohol or acetic acid, is precipitated from these solutions by water in the shape of a deep orange-red coloured flocculent precipitate, and with baryta and lime compounds it forms insoluble crimson-coloured combinations.

**Separation of Tarry Matter from Gas-Water.**—(Reply to "Gas Engineer").—If the gas liquor be first neutralised with oil of vitriol or other acid (by which an additional quantity of tarry matter held in solution by the alkaline ammoniacal compounds therein, will be set free), it should be agitated in suitable close vessels with successive small quantities of bisulphide of carbon, which can be drawn off and re-distilled with very trifling loss, the tarry products also being saved. If, on the contrary, it is essential that the gas liquor be treated before neutralisation, it must be agitated under similar circumstances with any light form of naphthol or commercial benzene. I recommend both methods, but especially the first-named, from practical experience.—WENTWORTH L. SCOTT.

## MEETINGS FOR THE WEEK.

MONDAY, Jan. 2nd.—Medical, 8.

TUESDAY, 3rd.—Royal Institution, 3. Prof. Odling, on "Burning and Unburning." (Juvenile Lectures.)  
— Zoological, 9.

THURSDAY, 5th.—Royal Institution, 3. Prof. Odling, on "Burning and Unburning." (Juvenile Lectures.)

FRIDAY, 6th.—Geologists' Association, 8.

SATURDAY, 7th.—Royal Institution, 3. Prof. Odling, on "Burning and Unburning." (Juvenile Lectures.)

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